Volume 22

Semicontinuous Water Quality Measurements at the Tracy Fish Collection Facility, Tracy, California, April 2001 to March 2002

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13. ABSTRACT *(Maximum 200 words)*
Water quality variables temperature, hydrogen-ion concentration (pH), dissolved oxygen, conductivity, oxidation-reduction potential, and turbidity were measured at 30-minute intervals using a calibrated Hydrolab Datasonde 4a multiprobe installed in the Old River at the Bureau of Reclamation's Tracy Fish Collection Facility (TFCF), located near Tracy, California, in the southern region of the Sacramento-San Joaquin River Delta. This is the second year of validated data collection and covers data collection from April 1, 2001, through March 31, 2002. The water quality data were compared to local meteorology, hydrology, tides, export pumping at State and Federal pumping plants, fish salvage, and temporary barrier installation and removal schedule data. Water quality data for April 1, 2001, through March 31, 2002, were comparable to the previous year's validated data. Annual median values were 18.1 °C for temperature, 463 microsiemens per centimeter for conductivity, 7.9 milligrams per liter for dissolved oxygen, 554 millivolt for redox potential, 7.65 for pH, and 24.8 Nephelometric turbidity units for turbidity. The most significant influence on water quality appears to be the status of nearby temporary channel barriers and the operation of the Delta Cross Channel near Walnut Grove, California. When barriers are installed and the Cross Channel gates are open from April through October, daily variations and maximum conductivity are much lower than when higher conductivity water from the San Joaquin River flows relatively unimpeded to the TFCF.

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Semicontinuous Water Quality Measurements at the Tracy Fish Collection Facility, Tracy, California, April 2001 to March 2002

by

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COVER

Fish photography by Rene Reyes, Tracy Fish Collection Facility, Tracy, California.
Design by Doug Craft.

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EXECUTIVE SUMMARY

This report presents semicontinuous data for several water quality variables measured using a Hydrolab Datasonde 4a multiprobe (Hydrolab, Inc.) installed at Reclamation's Tracy Fish Collection Facility (TFCF), Tracy, California. The TFCF is the fish salvage facility at the head of the intake canal for the Tracy Pumping Plant (TPP), and removes entrained fish from Old River water before it is pumped into Reclamation's Delta Mendota Canal by the TPP. These facilities are located in the southern region of the Sacramento-San Joaquin River Delta (South Delta) that flows into San Francisco Bay in northern California.

The purpose of this study is to provide reliable baseline water quality data from the TFCF intake channel to aid fishery scientists and engineers performing experimental work to improve fish salvage. This program is required by the Central Valley Project Improvement Act of 1992 (CVPIA) and is a subproject of the Tracy Fish Facility Improvement Program (TFFIP), administered by the Reclamation Mid-Pacific Region, Sacramento, California.

This is the second year that a calibration and maintenance program has been in place for the Datasonde multiprobe, and the second report providing baseline water quality data for the TFCF. The variables measured in the Old River at the TFCF intake included temperature (T), pH, dissolved oxygen (DO), electrical conductivity (EC), oxidation-reduction (or redox) potential (Eh), and turbidity. The multiprobe was cleaned and calibrated on a weekly schedule, and data downloaded at monthly intervals from April 2001 through March 2002. Conterminous data sets for meteorology, tides, photo period, hydrology and irrigation pumping, fish salvage, and schedules for temporary barrier installation and removal were also compared to the water quality data. The water quality and supplemental data have been validated, peer-reviewed, collated, and archived in a Microsoft® Access database and are available on request.

Water quality data for April 1, 2001, through March 31, 2002, are comparable to the previous year's data despite a 29 percent decrease in San Joaquin River discharge compared to year one. Table ES-1 provides a summary of minimum, maximum, and median values for each of the measured water quality variables.

TABLE ES-1.—Summary water quality values observed in the intake channel of the Tracy Fish Collection Facility from April 1, 2001, through March 31, 2002

Water Quality Variable	Minimum Value	Maximum Value	Median Value
Temperature, in degrees Celsius	7.4	27.1	18.1
Electrical conductivity, in microsiemens per centimeter	236	1060	463
Dissolved oxygen, in milligrams per liter	3.33	11.7	7.94
Oxidation-reduction potential, in millivolts	252	653	554
pH, in standard units	6.29	8.47	7.65
Turbidity, in Nephelometric turbidity units	1-5 (detection limit)	>300	24.8

Daily variation for EC was greatest from February through March when temporary barriers were removed. Median percent DO saturation was 85.8 percent. DO saturation percentage was below 50 percent 0.05 percent of the time (around four hours during the year) and below 75 percent 13 percent of the time. pH less than 7 was observed 3.0 percent of the time and pH greater than 8.0 was observed 13 percent of the time. While turbidity was observed as high as 525 Nephelometric turbidity units (NTU), values above 100 NTU are well beyond the calibration range of the probe and represent very short duration spikes. Ten percent of turbidity data exceeded 48.9 NTU and 0.5 percent were greater than 100 NTU.

Other than basin-wide factors (hydrology, tides, and climate), the most significant influence on water quality at the TFCF appears to be the installation and removal of temporary channel barriers and operation of the Delta Cross Channel near Walnut Grove, California. When barriers are installed and the Cross Channel gates are open from April through October, daily variation and maximum EC are much lower than when higher conductivity water from the San Joaquin River flows relatively unimpeded to the TFCF. Another factor that may affect local water quality at the TFCF is the operation of the gates at Clifton Court Forebay during high tides. When temporary barriers are installed, the gate operations may be clearly seen in the probe depth data; however, the effect on water quality is more complex and deserves further study.

INTRODUCTION

This report is the third in a series from the subproject, *Chemical Monitoring and Assessment at the Tracy Fish Facility*, which is part of the Tracy Fish Facility Improvement Program (TFFIP). The TFFIP is an interdisciplinary research and evaluation program started in 1989 and required by the Central Valley Project Improvement Act of 1992 (CVPIA) to investigate design and operational improvements for the Tracy Fish Collection Facility (TFCF). The TFCF, located at the head of the intake channel for the Tracy Pumping Plant (TPP), was designed to collect (salvage) fish to prevent them from being pumped through the TPP into the Delta Mendota Canal (DMC). The TFCF represented state-of-the-art technology when originally installed in the 1950s; however, changing fishery and regulatory conditions have mandated updating of fish salvage technology and improvements. TFFIP fish salvage technology research and development benefits design and assessment for Reclamation's Tracy Demonstration Fish Facility (TDFF), a planned research facility to be located across the channel from the TFCF. Knowledge gained from these research efforts and facilities will also be applied for design and construction of future fish salvage facilities in the Sacramento-San Joaquin River Delta (South Delta).

The purpose of this TFFIP subproject is to develop a reference or "baseline" water quality data set that combines historical water chemistry data, agricultural chemical application data, data from semicontinuous Hydrolab probe monitoring of general water quality variables, and chemical analysis data from future water samples collected at the TFCF. A baseline water quality data set is important to the TFFIP because water quality influences the health of the local fish populations. During 1999, personnel from the Bureau of Reclamation (Reclamation) Mid-Pacific (MP) Regional Office, Sacramento, California, began a Hydrolab multiprobe calibration and maintenance program. This report summarizes the second full year of successfully validated multiprobe water quality measurements at the TFCF and is the followup to the Tracy Series Volume 17 report (Craft et al. 2002).

Project Background

Both the TFCF and the TPP were built in the early 1950s as part of the Reclamation's Central Valley Project (CVP), a large water diversion infrastructure project that enabled agricultural expansion throughout most of the Central Valley of California. The Tracy facilities are located approximately 8 kilometers (km) northwest of Tracy, California. (See map in figure 1.)

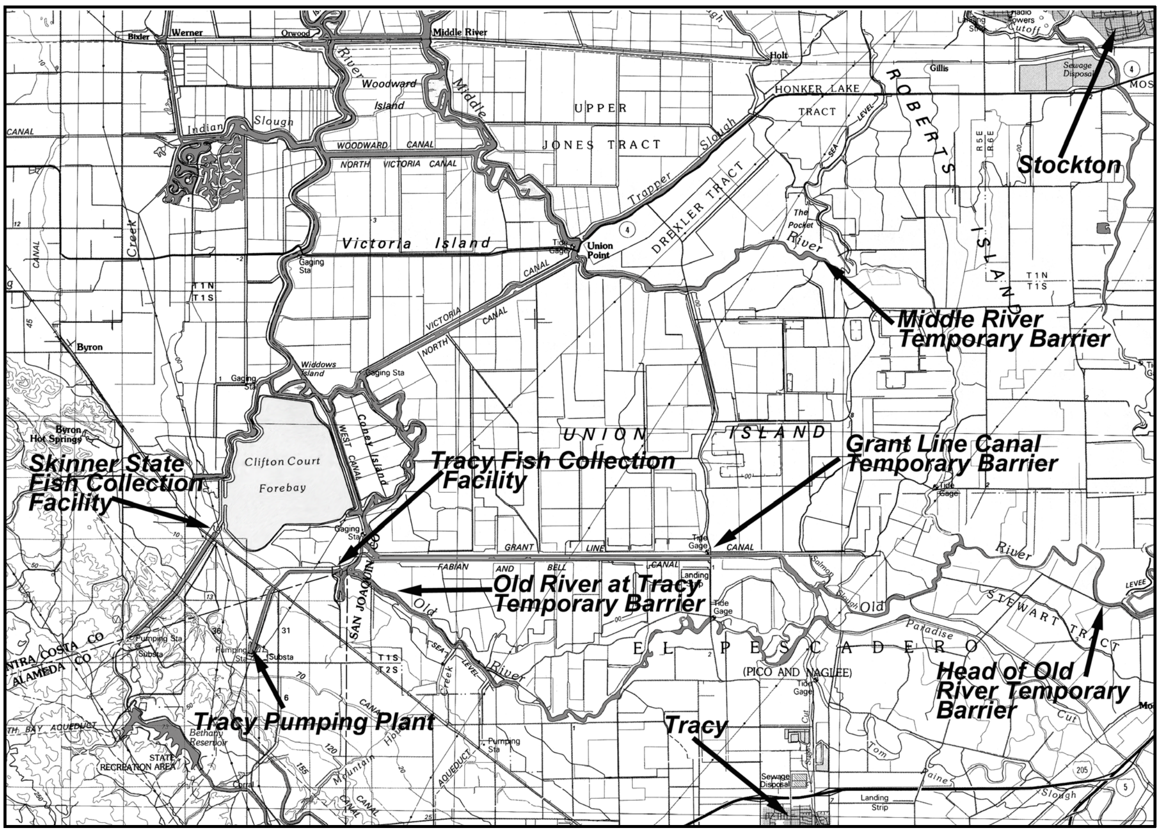


FIGURE 1.—Location of the Tracy Fish Collection Facility.

The TPP pumps water for irrigation, municipal, and industrial uses from the Old River into the DMC, which then flows southeast from the fish salvage and pumping facilities. The California Aqueduct is a similar nearby water diversion facility operated by the State of California (the State facility) at Clifton Court Forebay, located north of the TFCF. Before the CVP and similar State diversion systems were implemented, the San Joaquin River (SJR) water flowed north unimpeded into San Francisco Bay. Much of the SJR is now diverted south in the DMC, the Friant-Kern Canal, and other

State and Federal canals. Water from the South Delta is conveyed by a series of pumping stations on the DMC to the Mendota Pool to replace water diverted to the Friant-Kern Canal. DMC water flows by gravity southward down the San Joaquin Valley in a network of canals and then returns by way of the SJR (Liston et al. 1993).

General Factors Affecting Water Quality at the TFCF

The chemistry of TFCF intake water from the Old River, a South Delta distributary of the SJR, is the result of many variables interacting in a complex manner. Regional influences include basin-wide interactions between agricultural land use and runoff within the marine sedimentary geology of the Central Valley of California. The regional influences can change year to year because of hydrologic cycle variability and other trends, such as increasing urban populations and land use changes. Local influences include large-scale South Delta mixing of SJR and Sacramento River freshwater sources converging on San Francisco Bay, daily tidal fluctuations, artificial pumping from the TPP and entrainment of high tides at the State facility at Clifton Court Forebay, local irrigation return flows and chemical applications on crops, intermittent channel dredging, and the seasonal installation (usually in April and May) and removal (usually in September through November) of temporary channel barriers in the South Delta. The temporary barriers are embankments of piled rocks across the flow channels that retard return flow of high tide inflows and appear to influence the quality of water pumped through the TFCF. The complex interactions that produce the water quality observed at the TFCF underscore the need for accurate measurements that are location and temporally representative.

A major source water at the TFCF is the SJR; however, operation of diversion structures, such as the Cross Channel Canal near Walnut Grove, California, also allow for southerly transport and mixing of lower concentration Sacramento River water (median electrical conductivity [EC] = 150 microsiemens per centimeter [:S/cm]) into the South Delta near Tracy (State of California 1999, Craft et al. 2000). Old River water at the TFCF intake contains total dissolved solids (TDS) ranging from 300 to 1,100 milligrams per liter (mg/L), with median EC of 479 :S/cm (Craft et al. 2000), and contains sodium and chloride as the principal inorganic constituents. Daily tidal EC fluctuations of 100 to 300 :S/cm are commonly observed at the TFCF. The fluctuations are thought to be caused by up-gradient transport and mixing of lower concentration waters from the Mokelumne River and Sacramento River by the rising tidal salt wedge (State of California 1999). When local inflows from the SJR are further impeded by temporary channel barriers and the opening of the Delta Cross-Channel Canal, increased influence from lower concentration water from the northern Central Valley watersheds may help produce better water quality (lower EC) and lower daily variation in EC at the TFCF.

Agricultural activity and associated chemical applications occur in the immediate vicinity of the TFCF (Craft et al. 2000). Irrigation return flows may contain nitrogen and phosphorus from fertilizer applications, dissolved and suspended organic carbon from vegetation decay, and herbicide, pesticide, and fungicide chemicals and their formulation additives (usually surfactants, adjuvants, and sticking agents). Storm runoff may also mobilize suspended matter, which increases turbidity and organic carbon in local waters. These varying and unpredictable chemical inputs enter the Grant Line and Fabian and Bell Canals, the Victoria and North Canals, the Tom Paine Slough and the Paradise Cut, and the Old and Middle Rivers.

METHODOLOGY

Hydrolab Datasonde

Temperature (T, in degrees Celsius [°C]), hydrogen-ion concentration (pH), dissolved oxygen (DO, in mg/L), EC, redox potential (Eh in millivolts [mV]), probe depth (in m), and turbidity (in Nephelometric turbidity units [NTU]) were measured at 30-minute intervals using a Hydrolab Datasonde multiprobe installed in a perforated pipe located behind the trash rack and intake structures of the TFCF (Craft et al. 2002). The Datasonde probe assembly included a stirrer which was activated during programmed probe measurements. Personnel from the Reclamation MP Region performed routine calibration and maintenance of the Datasonde on a weekly schedule. Reference photographs and the standard operating procedure followed for calibration and maintenance activities may be found in Craft et al. (2002). After the probe assembly was cleaned, EC was calibrated using a certified standard reference solution, pH using a two-buffer (VWR Scientific) calibration, and Eh using Zobell's solution. DO was calibrated using air saturated with water at a measured barometric pressure, and turbidity was calibrated using a certified 50 NTU microbead standard. Calibration for the Datasonde probe was verified before reinstallation in the PVC pipe, and calibration checks and notes were recorded on field sheets and in the field logbook. Turbidity measurements were also checked independently using a separate calibrated turbidity meter.

Computer and Database Methods

Datasonde readings were stored on internal probe memory and downloaded monthly to a PC using HyperTerminal software via the Surveyor 4a data logger. These data were then transmitted as ASCII text e-mail attachments that were imported into Microsoft® Excel spreadsheets. Data were then reviewed, plotted, and shared with the field crew for any required corrective actions. Anomalous data, such as negative values, extreme turbidity readings (>300 NTU), or values measured when the probe was not in the water, were discarded. Monthly water quality data files were combined in Excel to create the entire period of record file that was imported into Microsoft® Access as an 18,984-record table. Queried water quality data were exported to Excel files and plotted to identify any additional anomalous values that were subsequently removed. Statistical analyses were performed using SPSS® (Statistical Package for the Social Sciences, Windows® version 8.0). Queries exported from Access as Excel files were then converted to SPSS® file format using DBMSCopy (version 6.06, SPSS, Inc.). Processed and altered SPSS® files were also returned to Access as new tables, imported via conversion to an Excel spreadsheet or appended using cut and paste PC operations.

Precipitation, air temperature, and sunrise and sunset times were obtained from the National Oceanic and Atmospheric Administration's National Climate Data Center web site, <http://www.ncdc.noaa.gov>, for weather station 049001 – Tracy Pumping Plant. Flow discharge in the San Joaquin and Sacramento Rivers was downloaded from the U.S. Geological Survey (USGS) web site, <http://water.wr.usgs.gov>, for gage stations 11303500 – San Joaquin River Near Vernalis, California; 11254000 – San Joaquin River near Mendota, California; 11274000 – San Joaquin River near Newman, California; and 11447650 – Sacramento River at Freeport, California.

Daily total pumping at the TPP and Cross Channel operations data were obtained from the Reclamation Central Valley Operations Office, Sacramento, California. Operational schedules for the South Delta temporary barriers were obtained from the California Department of Water Resources, Office of State Water Project Planning web site, <http://sdelta.water.ca.gov/web_pg/tempmesr.html>.

Temporary barrier (T.B.) and Delta Cross Channel gate status data were coded as follows:

TABLE 1.—Coding used to describe operations of temporary barriers and other events affecting the chemistry at the TFCF

Event	Installation	Installed	Removal	Not Installed
Old River at TFCF T.B.	5	1	5	0
Grant Line Canal T.B.	6	2	6	0
Head of Old River T.B.	7	3	7	0
Middle River T.B.	8	4	8	0
Delta Cross Channel Gates	N/A	1.5 (open)	N/A	0 (closed)
Channel Dredging	N/A	6.5 (yes)	N/A	0 (no)
Calibration Events	N/A	0.5 (yes)	N/A	0 (no)
Multiprobe Power Failures	N/A	2.5 (yes)	N/A	0 (no)

Tidal, sunrise, sunset, and moon phase data were generated using harmonic constants in *Tides and Currents for Windows,* version 3.0, (Nobeltec Nautical Software, Beaverton, Oregon). Tidal data were calculated for the tide gage station located at the Grant Line Canal Bridge, approximately 11 km from the TFCF. These data provide a reference set to compare with Datasonde probe depth. Note that the actual tide stage at the Grant Line canal is significantly influenced by local runoff and water management operations; however, calculated values do not include these influences.

Fish salvage data for the TFCF and the Skinner Fish Collection Facility were obtained from the California Department of Fish and Game (Foss 2002).

RESULTS AND DISCUSSION

Table 2 summarizes parametric and rank statistics calculated for data collected from April 2001 through March 2002. Additional summary statistics are found in Appendix 1.

TABLE 2.—Summary of the second year of water quality data collected with the multiprobe at the TFCF

Statistic	*Water T, °C*	*EC, µS/cm*	*DO, mg/L*	*DO Percent Saturation*	*pH, su*	*Redox Potential, mV*	*Turbidity, NTU*
Valid n	16541	16548	16547	15129	16554	16559	16512
Missing n	975	968	969	2387	962	957	1004
Summary							
Mean	17.80	485	8.18	84.9	7.65	533	28.6
Median	18.10	463	7.94	85.8	7.65	554	24.8
Mode	23.90	338	7.72	88.5	7.47	565	18.0
Range	19.70	824	8.33	80.6	2.18	401	525.0
Minimum	7.40	236	3.33	38.3	6.29	252	<1.0
Maximum	27.10	1060	11.70	119.0	8.47	653	525.0
Percentiles							
0.1	7.55	243	4.90	54.9	6.32	269	5.05
1	8.00	259	5.64	63.3	6.52	302	7.60
5	8.70	282	6.24	69.1	7.08	350	11.40
10	9.70	302	6.61	72.5	7.27	413	13.60
20	11.40	335	7.08	78.8	7.41	485	16.40
25	12.80	348	7.28	80.5	7.45	505	17.50
30	13.80	362	7.44	81.8	7.48	518	18.70
40	15.90	404	7.69	84.0	7.57	537	21.50
50	18.10	463	7.94	85.8	7.65	554	24.80
60	21.10	506	8.31	87.4	7.75	567	28.60
70	22.50	551	8.83	89.0	7.83	581	32.80
75	23.20	573	9.08	89.8	7.86	589	35.30
80	23.70	599	9.48	90.9	7.91	597	38.40
90	24.40	722	10.10	94.3	8.06	614	47.80
95	24.90	849	10.50	98.2	8.15	623	56.40
99	26.10	985	10.90	105.0	8.37	636	82.20
99.9	26.60	1050	11.30	115.0	8.44	648	184.00

The appendix figure A1-1 histograms for each of the water quality variables suggest that the data distributions are complex, with only pH and DO approximating a normal distribution for the period of record. T and EC both exhibit multi modal distributions. The multiple modes in the T distribution are probably associated with seasonal changes, while EC bimodality is probably related to the installation and removal of temporary channel barriers. Redox and turbidity show more log-normal distributions. Examination of the monthly histograms suggested that distributional properties for all the multiprobe variables change throughout the year. Given the lack of normality in the data, the median and rank-based statistics were used as less biased indicators of central tendency and extreme values.

A factor to consider regarding the simple daily and weekly summaries presented here is the phase relationship of daily tides and the 2-week spring and neap tide cycle. The 24.8-hour tidal cycle will introduce biases for estimates based on calendar days and weeks and may also render statistical comparisons of diel effects inaccurate. These biases may be minimized by applying tidal filters to data sets before calculating daily and weekly estimates; however, tidal filters were not applied to this data set.

Table A1-1 shows monthly summaries that include more detailed percentiles in the tails of the data distributions where extreme values are observed. Because data were consistently collected at 30-min intervals, the percentiles may be used to approximate the length of time extreme values were observed. For example, table 3 shows that the 0.1 percentile value for T is 7.55 °C. We can infer that temperatures equal to or below this value were observed only 0.1 percent of the year, or for around 8 to 9 hours. This approach provides more meaningful data when extreme values approach or exceed regulated water quality standards.

Annual median T was 18.1 °C. and ranged from 7.40 °C. to 27.1 °C. Minimum EC was 236 :S/cm, with a maximum of 1,060 :S/cm and a median of 463 :S/cm. Daily variation for EC was greatest from February through March when temporary barriers were removed. Median DO was 7.94 mg/L and ranged from 3.33 mg/L to 11.7 mg/L. Median percent DO saturation was 85.8 percent. DO saturation percentage was below 50 percent 0.05 percent of the time (263 minutes out of a year) and below 75 percent 13 percent of the time. Eh ranged from 252 to 653 mV, with a median of 554 mV, suggesting an oxidizing environment consistent with the presence of dissolved oxygen. Because of mixed potentials arising from several different Eh reactions occurring on the surface of the platinum Eh electrode, DO is a better indicator of Eh conditions in oxygenated surface waters (Lindsay 1979;

Stumm and Morgan 1996). Median pH was 7.65 and varied from 6.29 to 8.47. pH less than 7 was observed 3.0 percent of the time, and pH greater than 8.0 was observed 13 percent of the time. Turbidity ranged up to 525 NTU; however, such extreme values are well beyond the calibration range of the probe and represent very short duration spikes. Median turbidity was 24.8 NTU; 10 percent of turbidity data exceeded 48.9 NTU, and 0.5 percent was greater than 100 NTU.

Figures 2a through 2e show detailed plots of multiprobe data collected for the period of April 1, 2002, through March 31, 2002. The previous year's data (Craft et al. 2002) are also plotted in lighter color in each graph for comparison. Figures 3a through 3e provide summary plots of daily, weekly, and monthly median values for the year one and year two water quality data.

Background Data

Background data and events are summarized in figures 4a through 4f. Figures 4a and 4b show installation and removal of nearby temporary channel barriers. Operation of the temporary barriers in the Old River near the TFCF, in the Grant Line Canal, and the operations of the Delta Cross Channel Gates are shown in figure 4a. Figure 4b shows channel dredging at the TFCF intake and the head of the Old River temporary barrier and the probe calibration and power disruption events. Hydrologic data are plotted in figures 4c and 4d. Pumping at the TPP and the nearby State facility are plotted in figure 4c, and figure 4d shows a logarithmic plot that combines streamflow (in cubic feet per second) from USGS gage stations on the Sacramento and San Joaquin Rivers and pumping at the TPP. Precipitation data from the TPP weather station are summarized in figures 4e and 4f. Figure 4e shows precipitation events, and figure 4f shows minimum, average, and maximum air temperatures.

The year-two hydrology data in figure 4d show that the SJR responded to spring snowmelt from late April through early June and streamflow peaked during winter rainy season storms in late October and early February. A comparison of the year-two streamflows (total runoff 1.51 X 10^6 acre-feet per year [a-ft/yr]) at the SJR at Vernalis, California, to year-one streamflows (2.14 X 10^6 a-ft/yr) reveals that year two was drier by 630,000 a-ft, a 29.4-percent decrease in runoff. Despite the drier basin-year, local precipitation at TFCF during the second year was similar to year one. Local precipitation during year two, seen in figure 4e was 11.8 in (29.8 cm). Rain was measurable 72 days during year two.

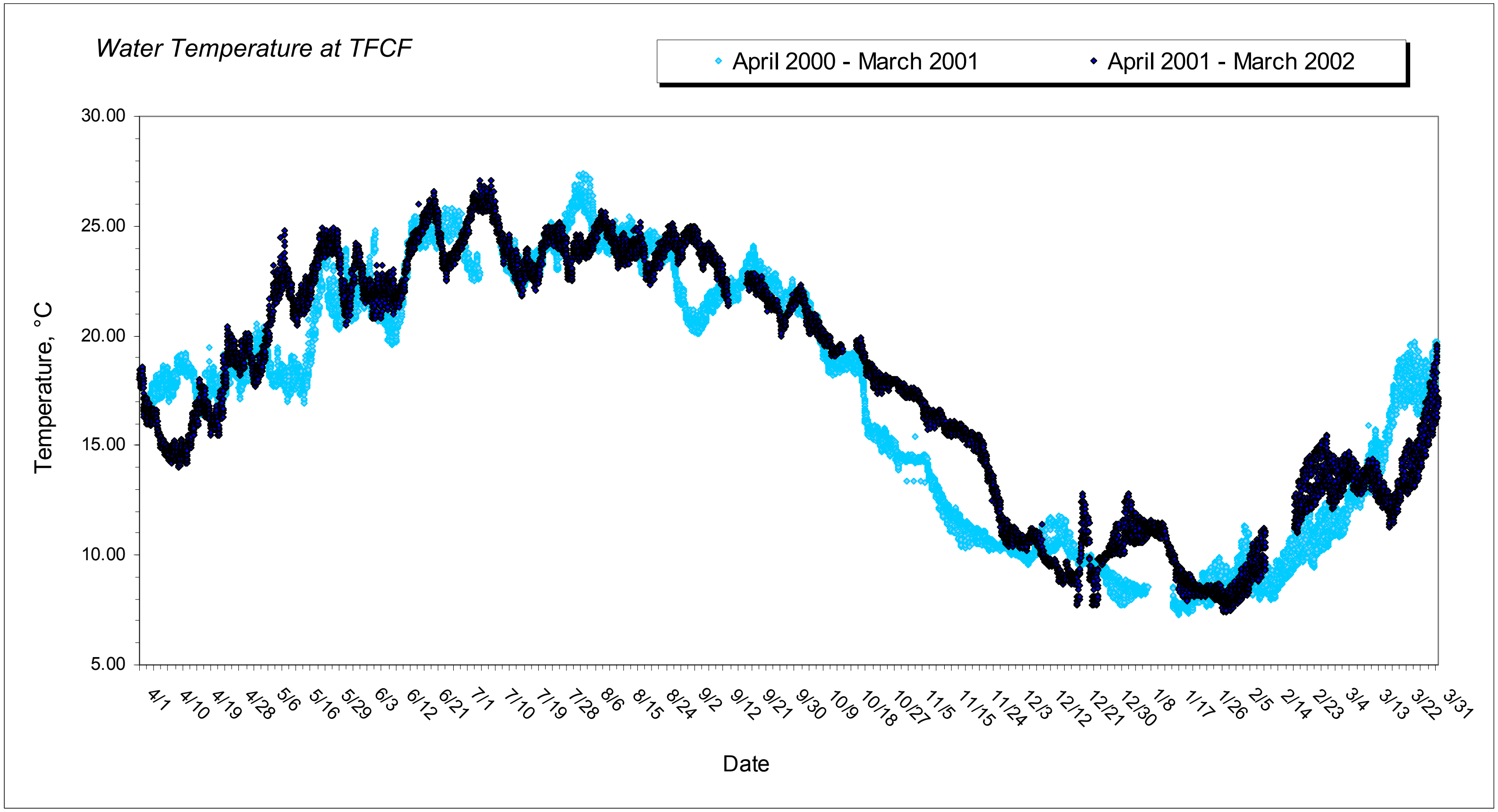


FIGURE 2a.—Two year record of Tracy Fish Collection Facility intake channel water temperature, in degrees Celsius. The darker plot represents the most recent year's data, and the lighter plot represents the first year's data (Craft et al. 2002).

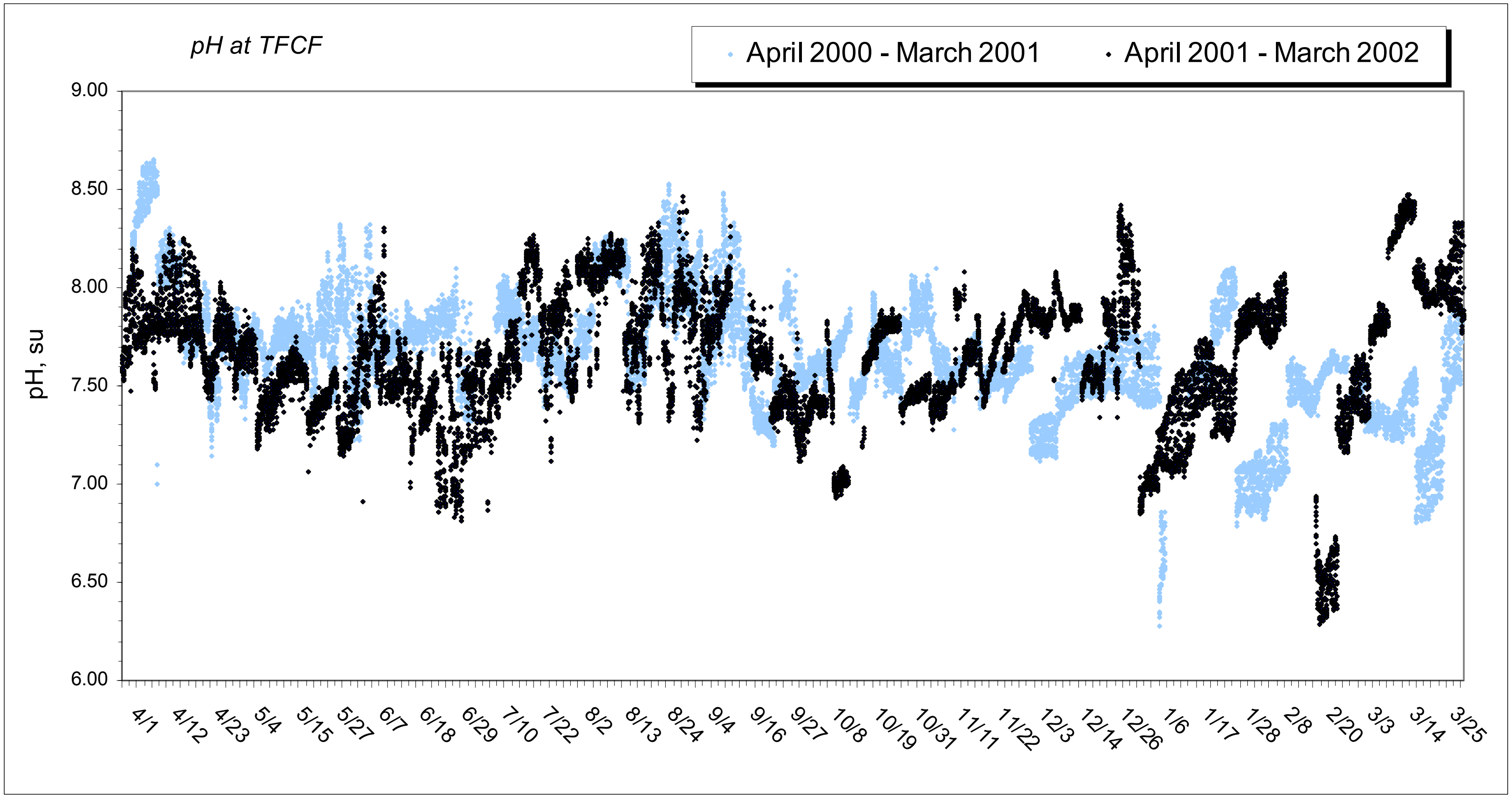


FIGURE 2b.—Two year record of Tracy Fish Collection Facility intake channel water pH, in standard units. The darker plot represents the most recent year's data, and the lighter plot represents the first year's data (Craft et al. 2002).

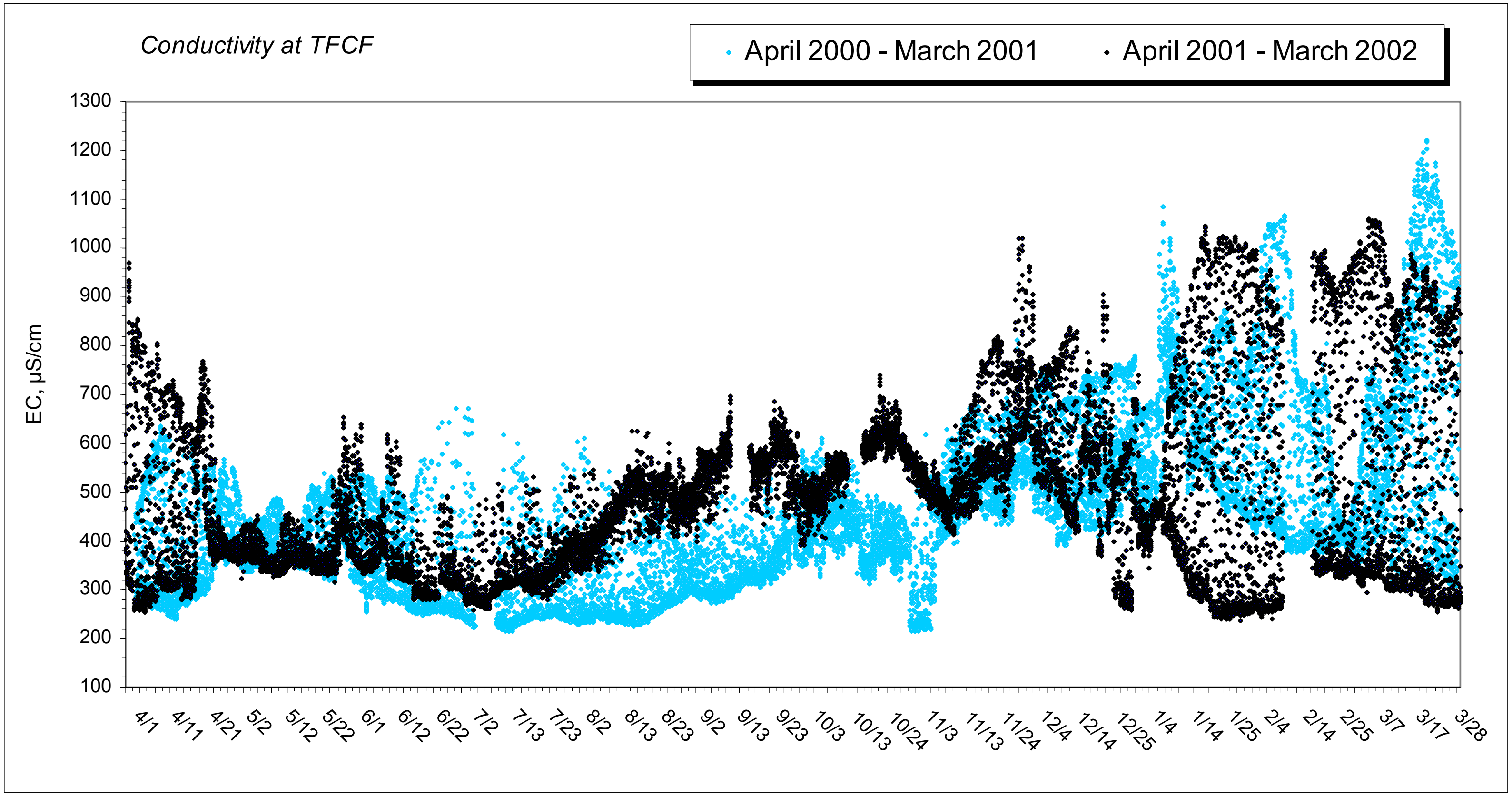


FIGURE 2c.—Two year record of Tracy Fish Collection Facility intake channel water electrical conductivity, in microsiemens per centimeter. The darker plot represents the most recent year's data, and the lighter plot represents the first year's data (Craft et al. 2002).

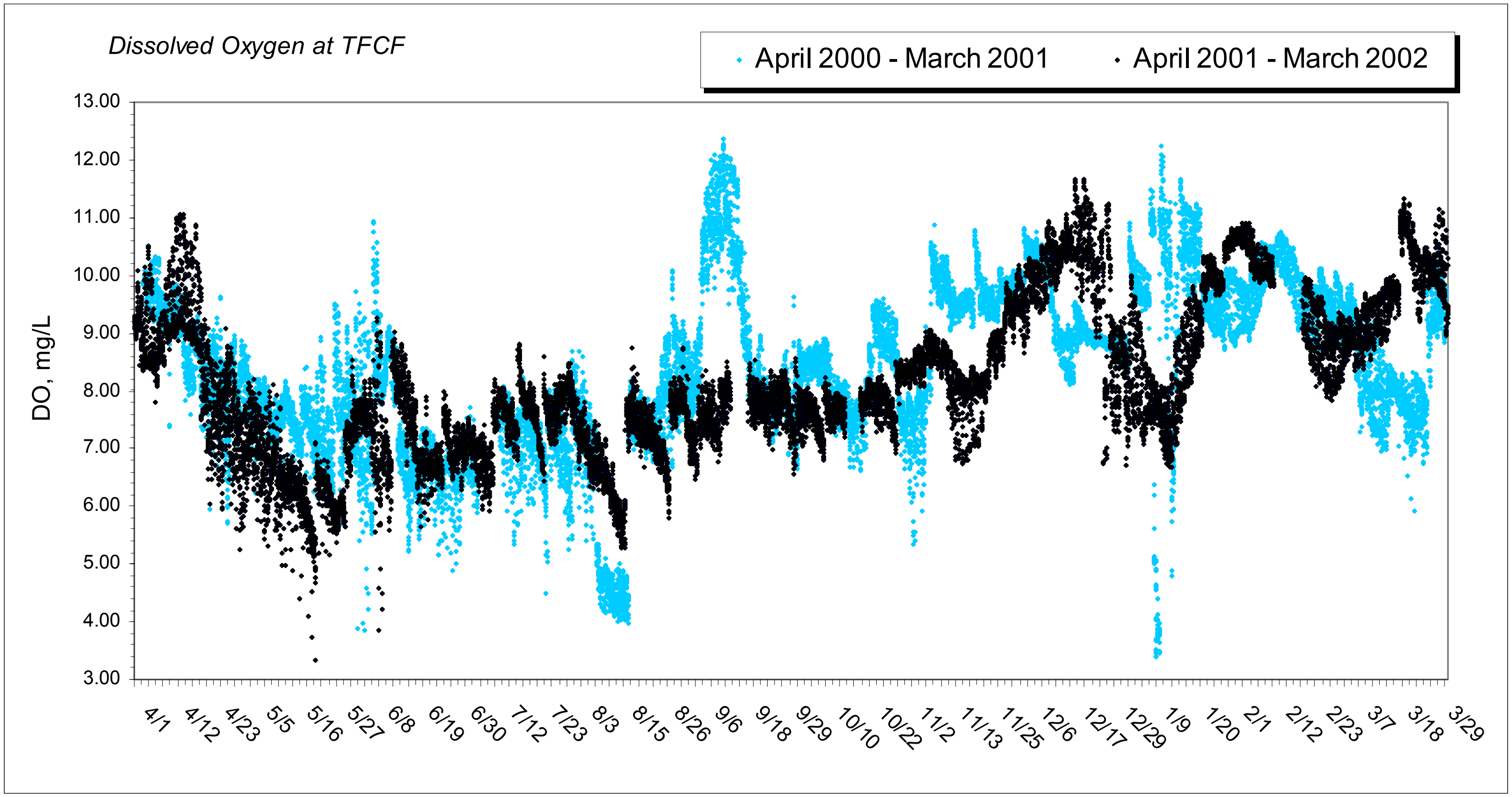


FIGURE 2d.—Two year record of Tracy Fish Collection Facility intake channel water dissolved oxygen, in milligrams per liter. The darker plot represents the most recent year's data, and the lighter plot represents the first year's data (Craft et al. 2002).

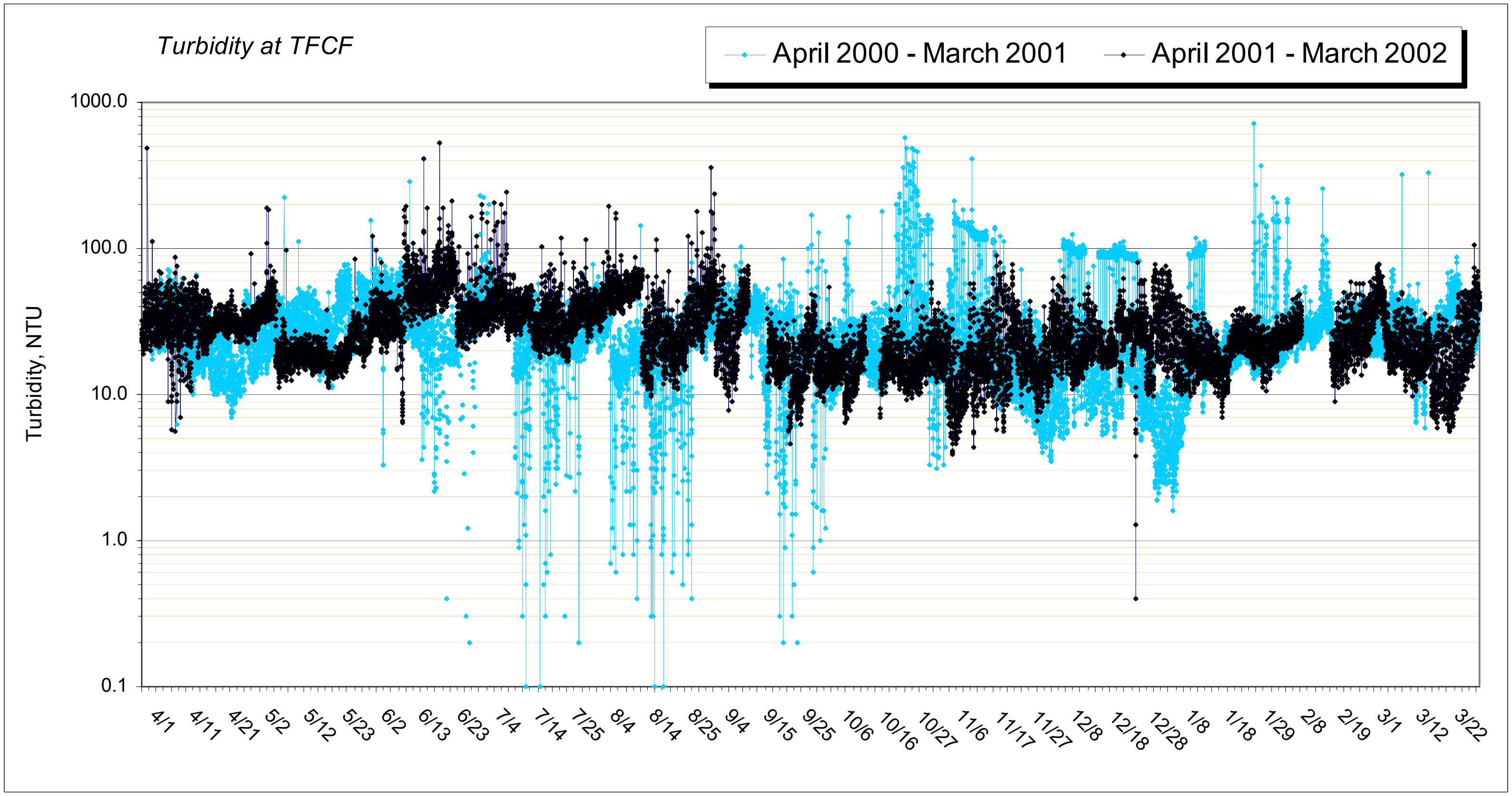


FIGURE 2e.—Two year record of Tracy Fish Collection Facility intake channel water turbidity, in Nephelometric turbidity units. The darker plot represents the most recent year's data, and the lighter plot represents the first year's data (Craft et al. 2002).

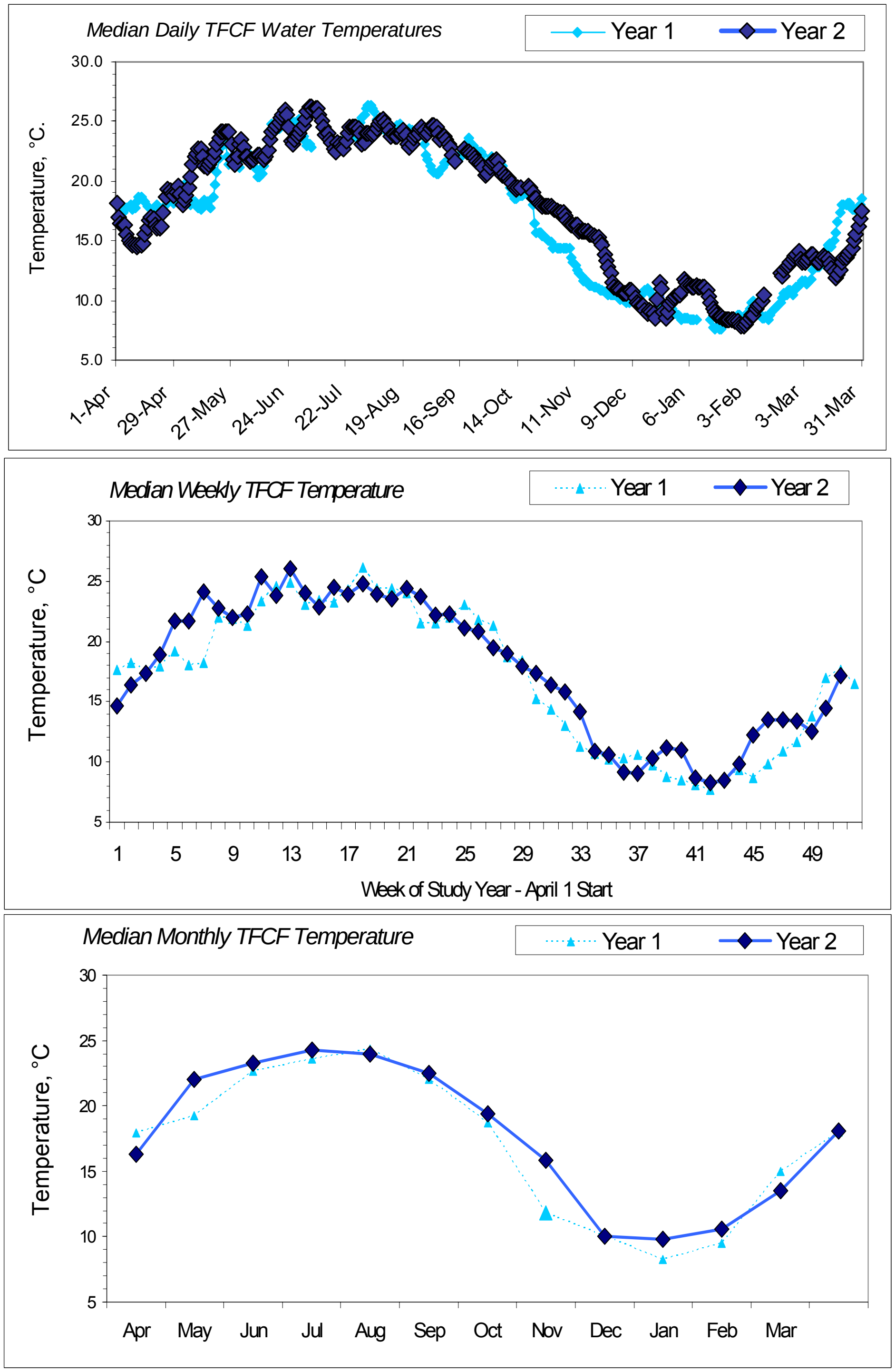


FIGURE 3a.— Daily, weekly, and monthly medians for water temperature, in degrees Celsius, for the intake channel at the Tracy Fish Collection Facility.

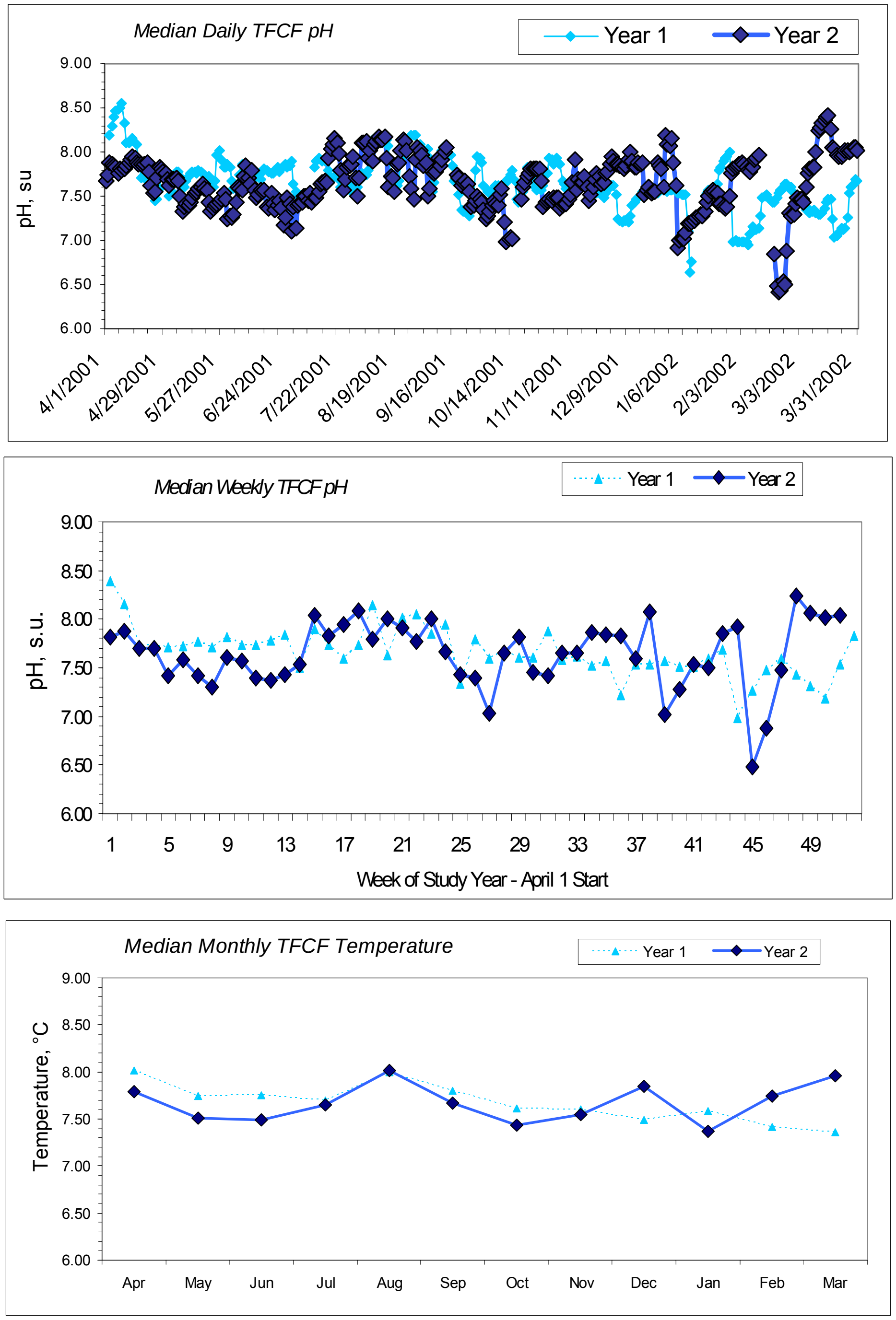
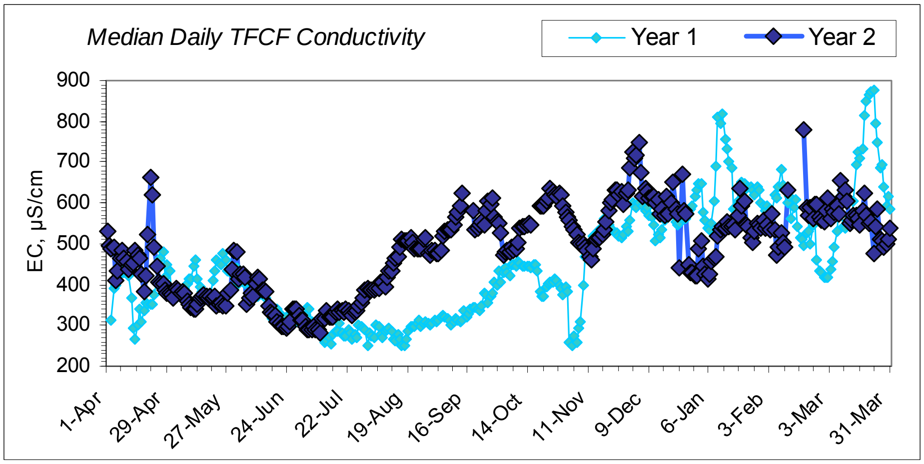
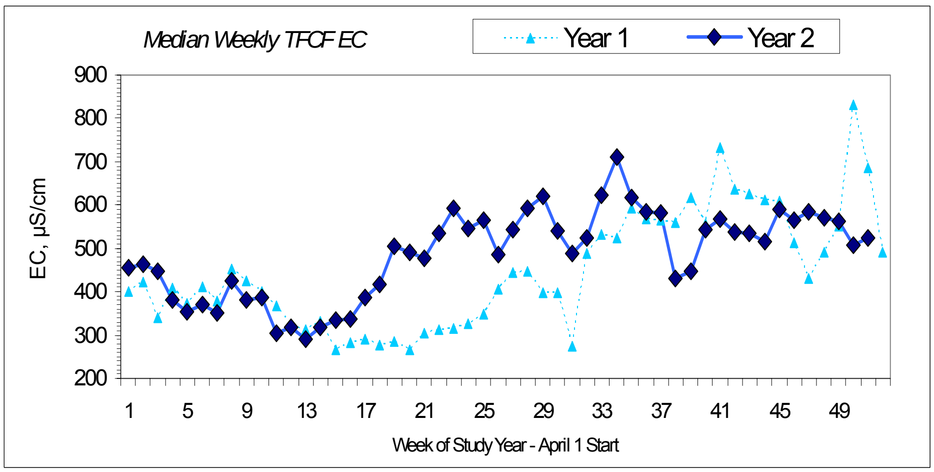


FIGURE 3b.—Daily, weekly, and monthly medians for pH, in standard units, for the intake channel for the Tracy Fish Collection Facility.





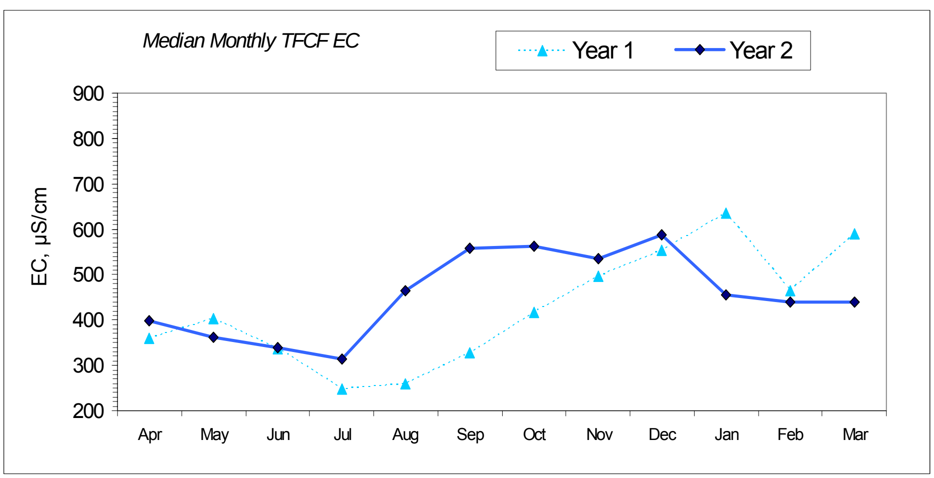


FIGURE 3c.— Daily, weekly, and monthly medians for conductivity, in microsiemens per centimeter, for the intake channel at the Tracy Fish Collection Facility.

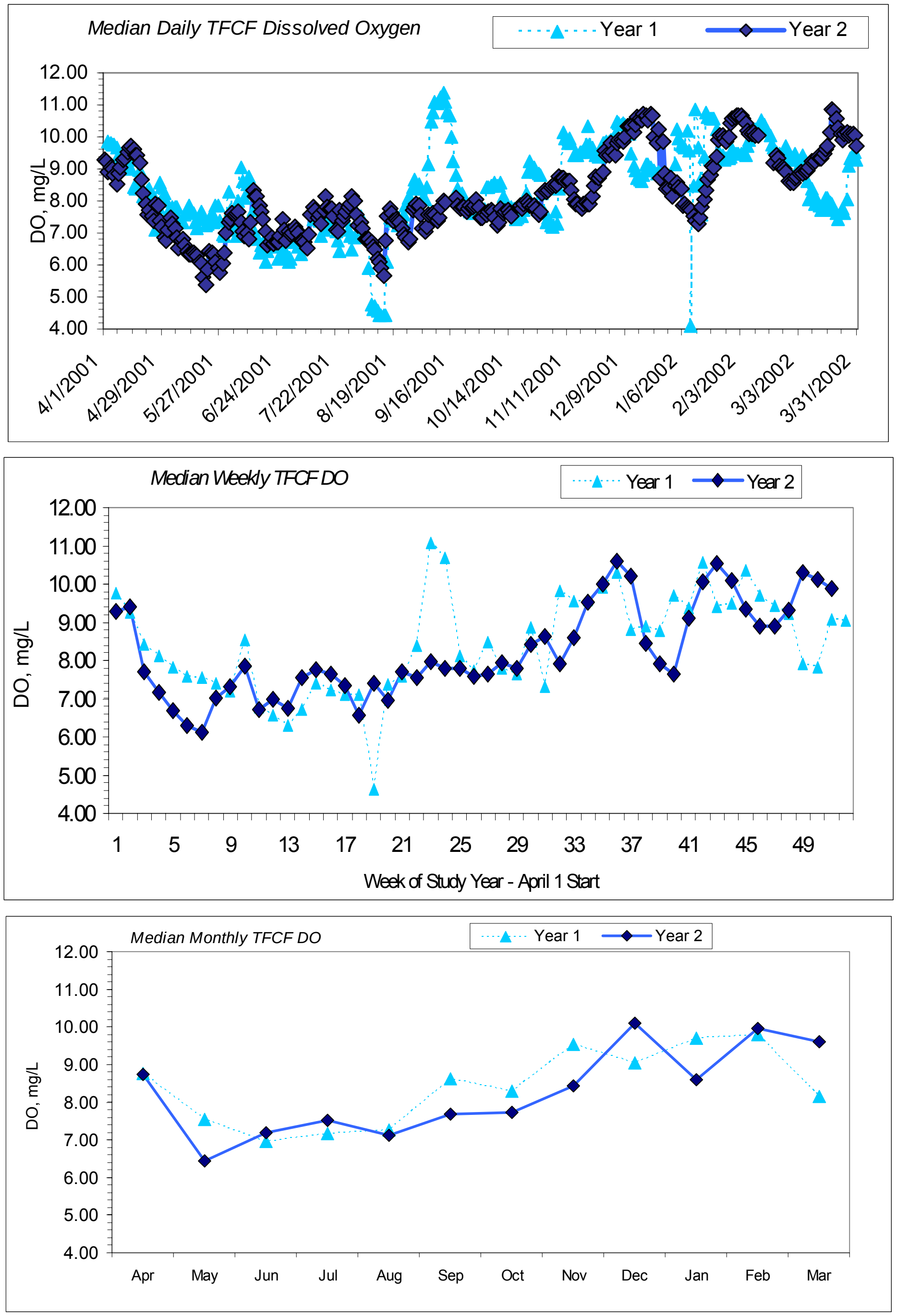
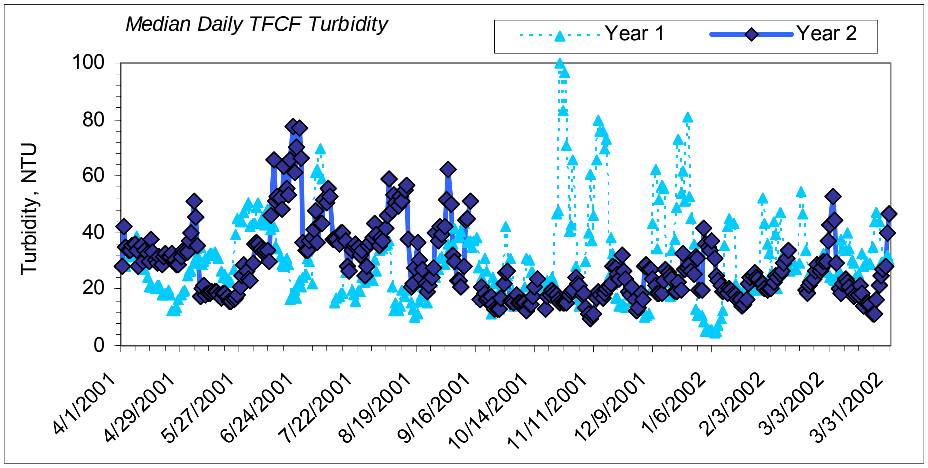
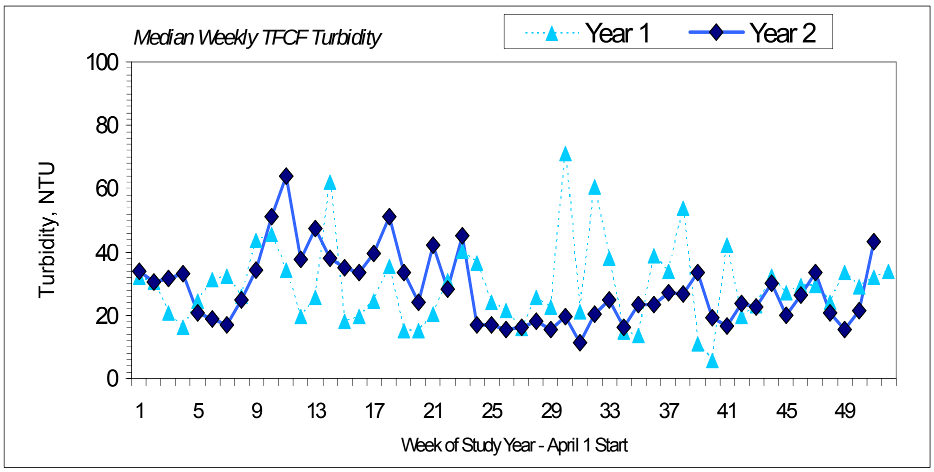


FIGURE 3d.— Daily, weekly, and monthly medians for dissolved oxygen, in milligrams per liter, for the intake channel at the Tracy Fish Collection Facility.





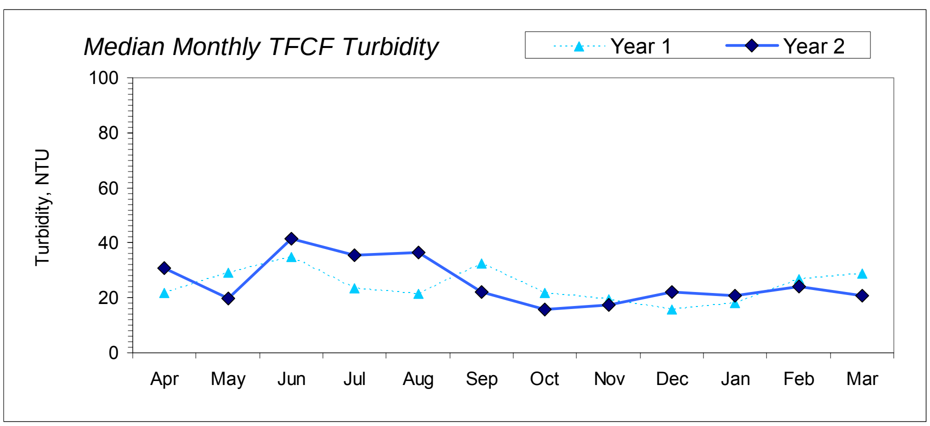


FIGURE 3e.— Daily, weekly, and monthly median values for turbidity, in Nephelometric turbidity units, for the intake channel at the Tracy Fish Collection Facility.

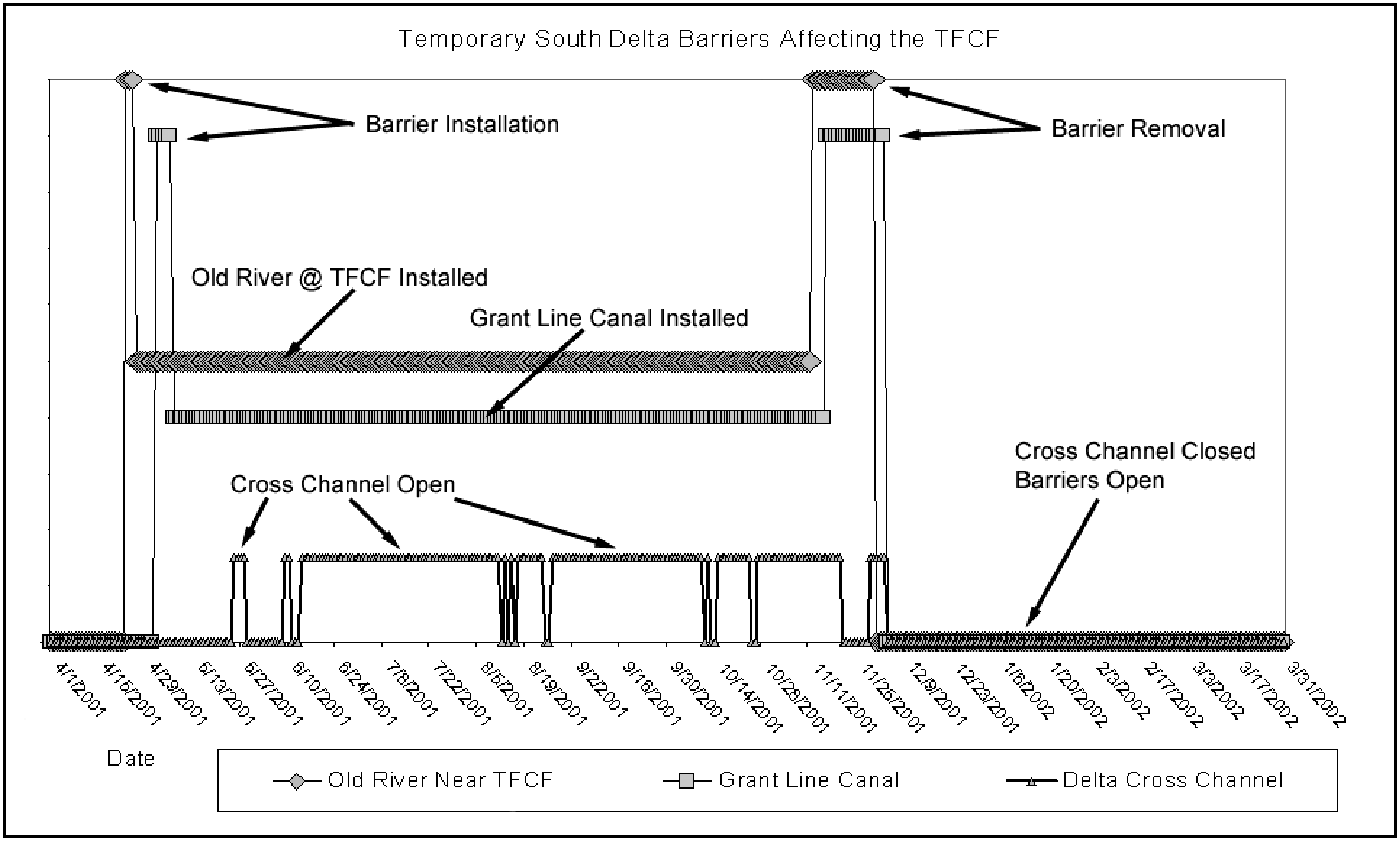


FIGURE 4a.—Nearby temporary barrier and Delta Cross-Channel Canal operational events affecting the Tracy Fish Collection Facility.

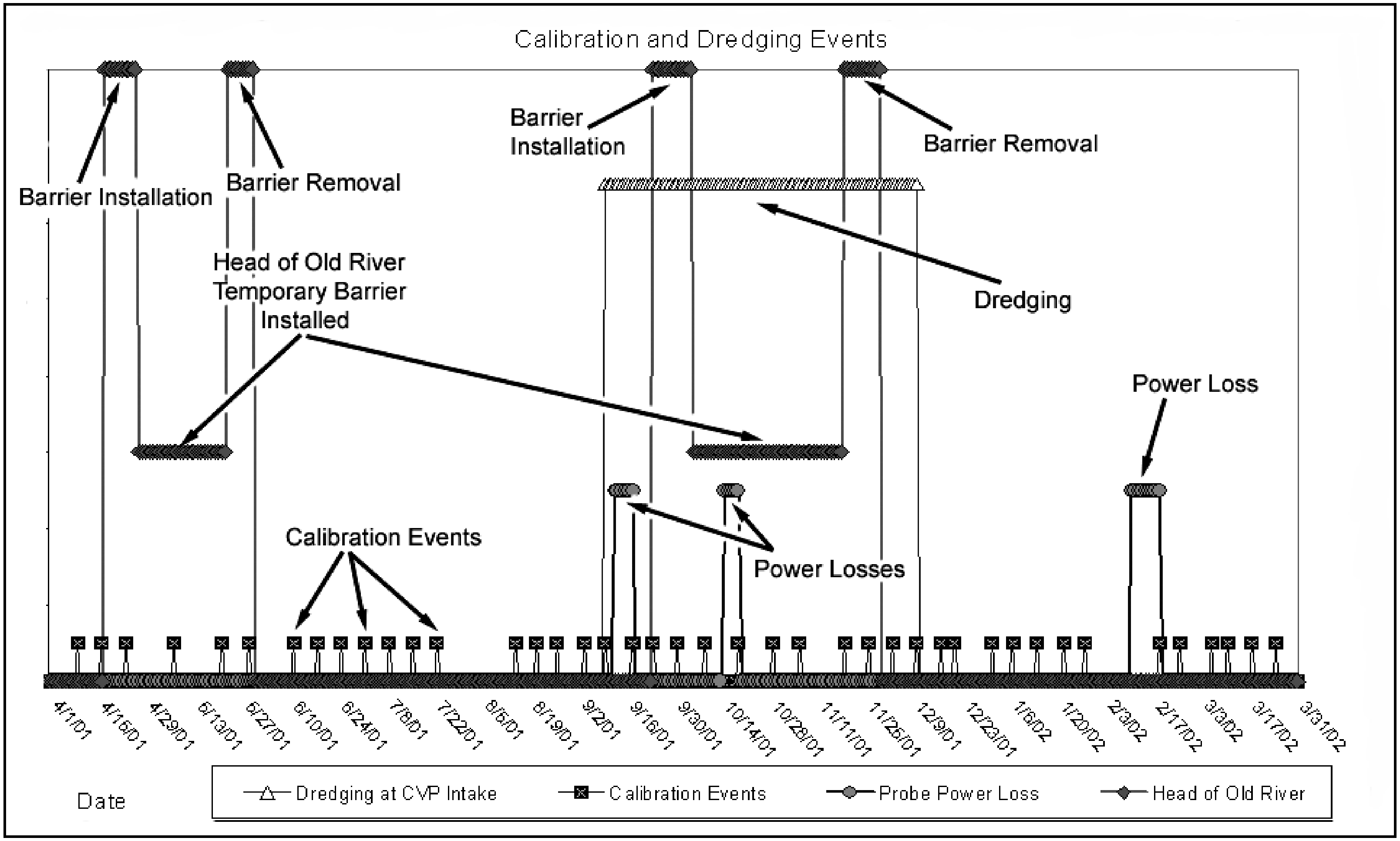


FIGURE 4b.—Head of Old River temporary barrier and channel dredging schedule along with Datasonde calibration schedule.

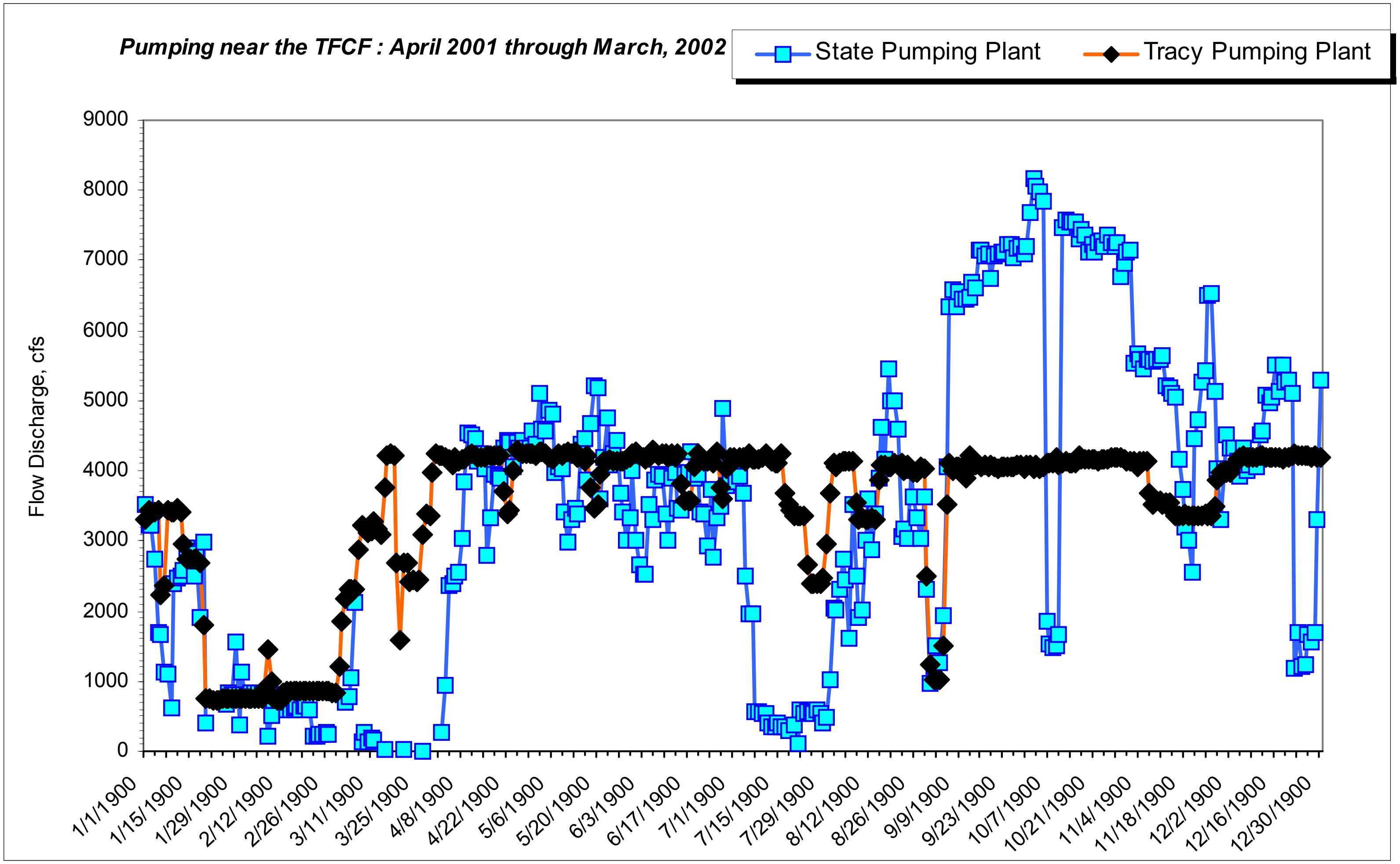


FIGURE 4c.—Daily pumping, in cubic feet per second, at the Tracy Pumping Plant and the State of California's Harvey O. Banks Pumping Facility.

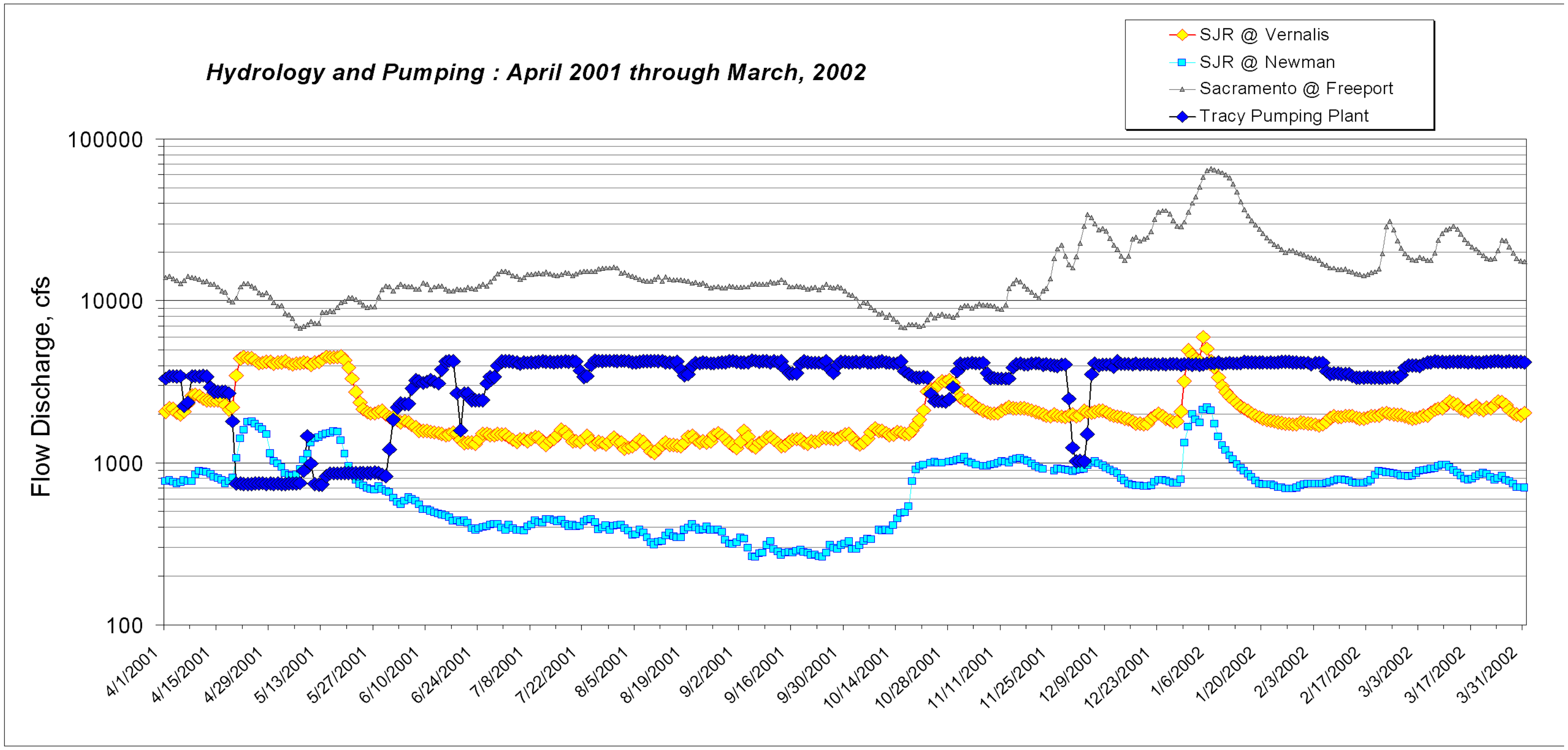


FIGURE 4d.—Flow, in cubic feet per second, for local rivers combined with pumping at the Tracy Pumping Plant. The data are plotted on a logarithmic scale.

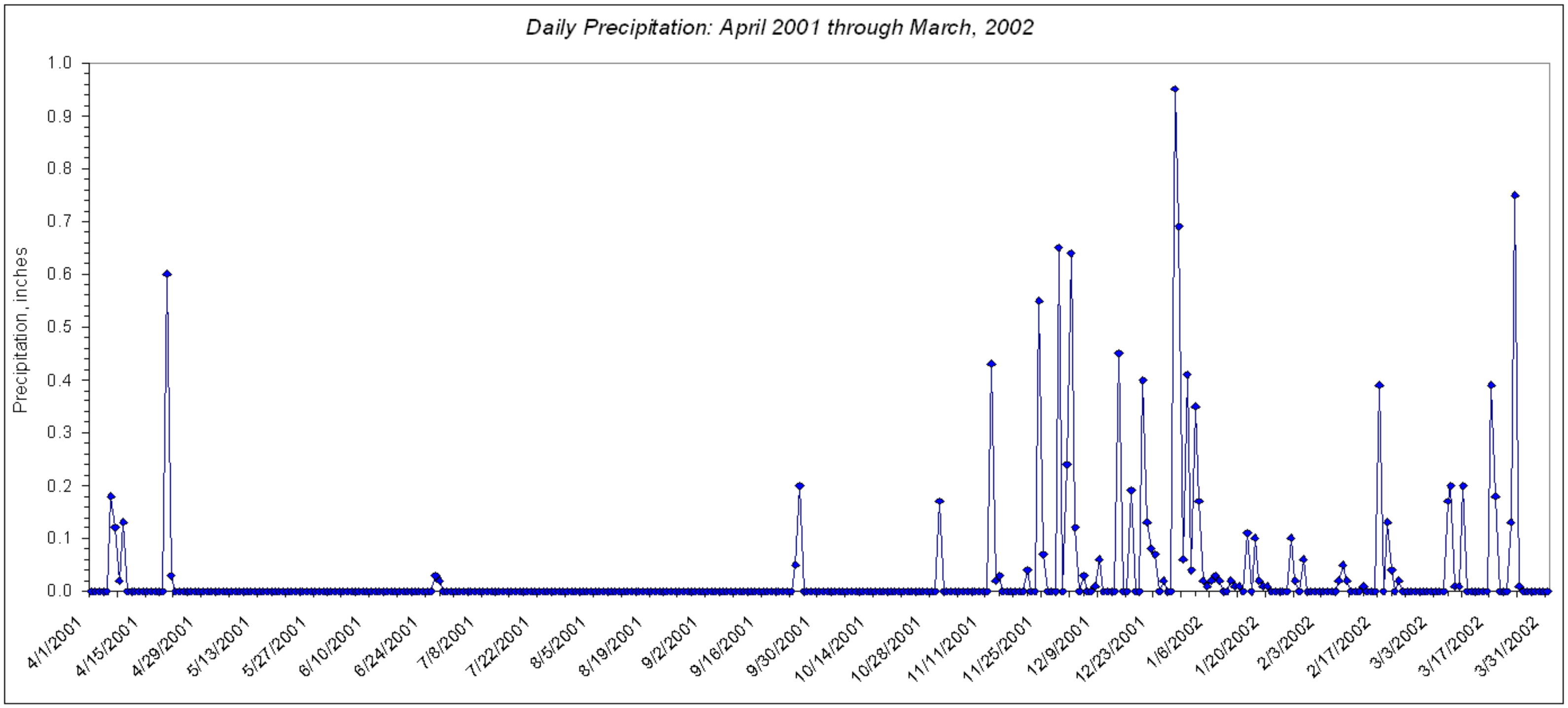


FIGURE 4e.—Precipitation events from April 1, 2001, through March 31, 2002.

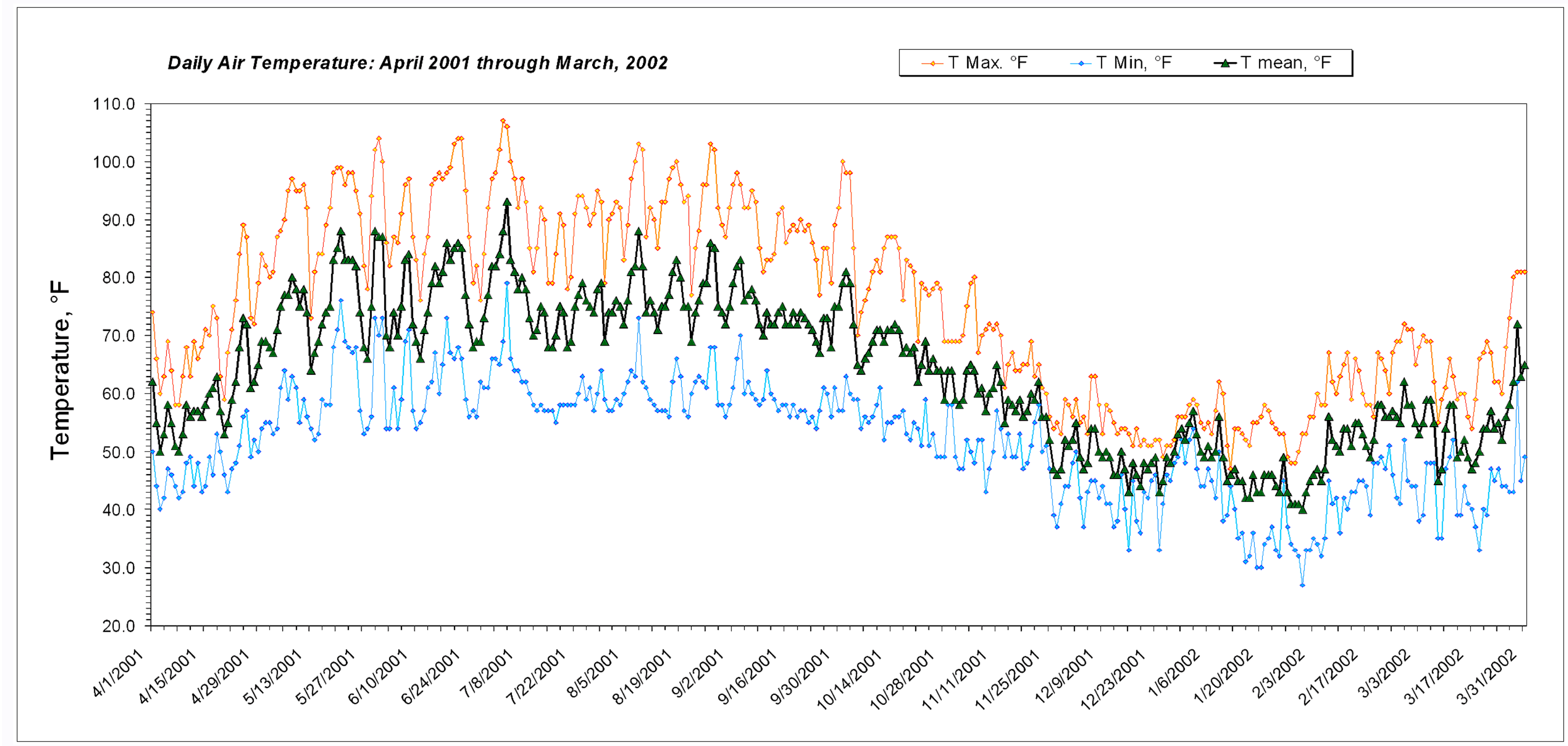


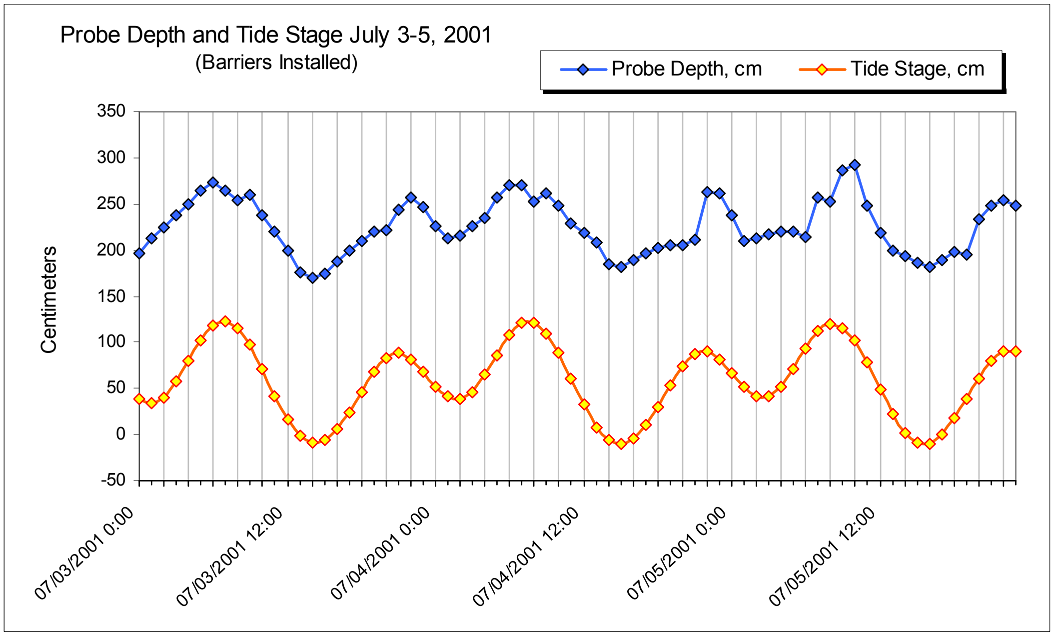
FIGURE 4f.—Minimum, maximum, and average air temperatures, in degrees Fahrenheit, at the Tracy Fish Collection Facility.

These data are comparable to year one's 64 days of measurable precipitation that totaled 11.1 in (28.2 cm). During mid-June through December, TPP pumping was approximately three times the discharge from the SJR at Vernalis, and year-two pumping was slightly elevated compared to year-one.

Figure 5 shows a 3-day comparison between measured probe depth and tidal stage calculated for the station in the Grant Line Canal located approximately 11 km from the TFCF. The upper graph shows probe depth and tide stage when temporary barriers are installed, and the lower graph compares tidal responses when temporary barriers are not installed. This figure demonstrates how measured tidal stage (by way of probe depth) is very different compared to theoretical calculations that do not account for local flow management and pumping. When barriers are installed and more inflow water comes from the north, the operation of the Clifton Court Forebay gates can be clearly seen as dips in the high tide peaks. When the local channels are open, the water level changes from the Clifton Court gates are not as apparent at high tides. Presumably, open channels encourage more inflow from the Old River upstream from Clifton Court Forebay.

Despite the complex variable interactions at the TFCF, figures 6a-6c show some interesting associations between some local events and responses in water quality (expressed as minimum and maximum daily values) and fish salvage. The most notable effects were observed for DO and EC, which appear to be associated with the installation and removal of temporary barriers. Figure 6a shows the DO (top graph) and EC along with temporary barrier status and dredging. DO shows its minimum value when barriers are installed; however, this is also the period when water temperatures are highest. Nonetheless, DO shows a rebound to higher values after barriers are removed and precipitation events increase in frequency. Electrical conductivity (bottom graph in figure 6a) shows a response in daily range to temporary barriers similar to that observed in last year's data: daily EC variability increases when barriers are removed and higher salinity SJR water flows into the TFCF from the Old River. Low EC variability is also associated with the opening of the Delta Cross Channel gates, which encourages greater flows to the South Delta of low EC water from the Sacramento River.

Figure 6b shows minimum and maximum turbidity along with local barrier status (top graph) and precipitation events (bottom graph). Here it is clear that higher turbidity values are seen when temporary barriers are installed, but interestingly, no apparent responses to barrier installation and removal or dredging. Perhaps the increase in turbidity is related to enhanced algal



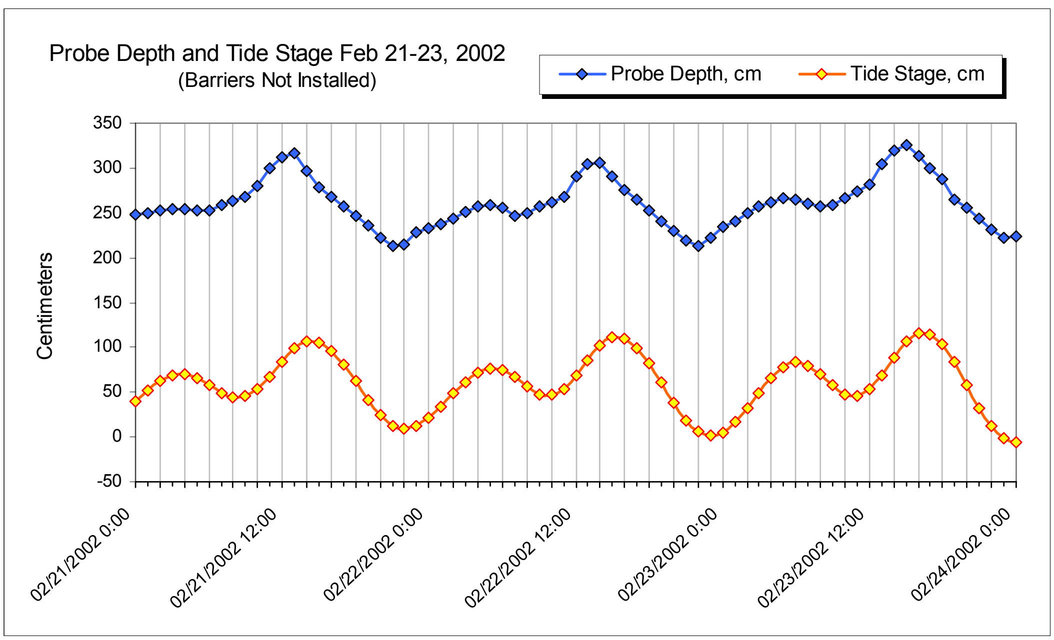
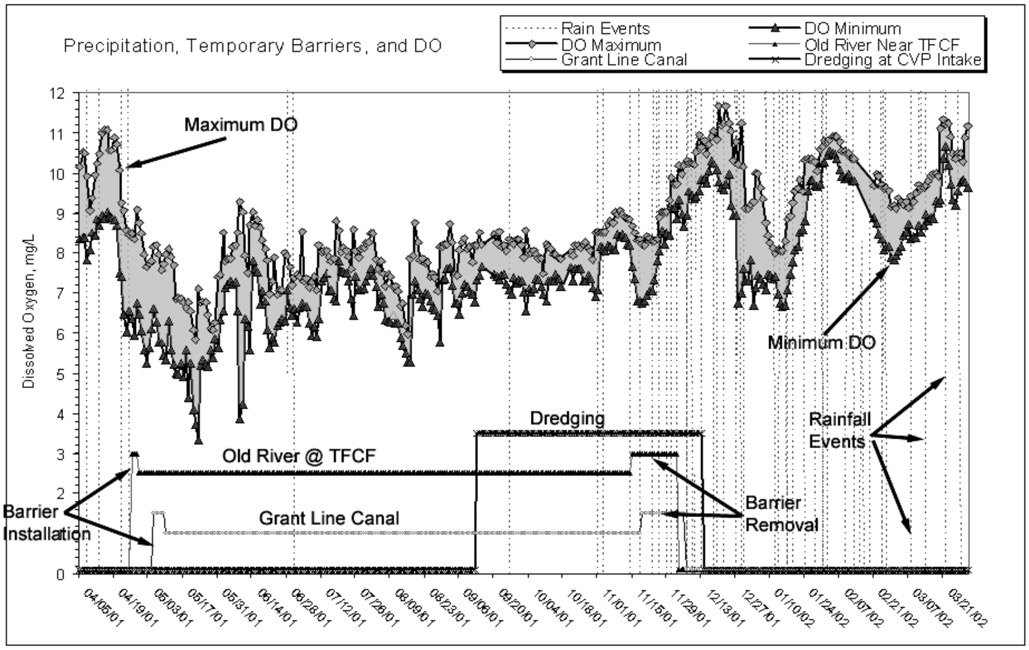


FIGURE 5.— Two detailed comparisons of probe depth at the Tracy Fish Collection Facility and tide stage calculated at the Grant Line Canal. The top graph is during July, when the local temporary channel barriers are in place, and the bottom graph is during February, when the channels are open.



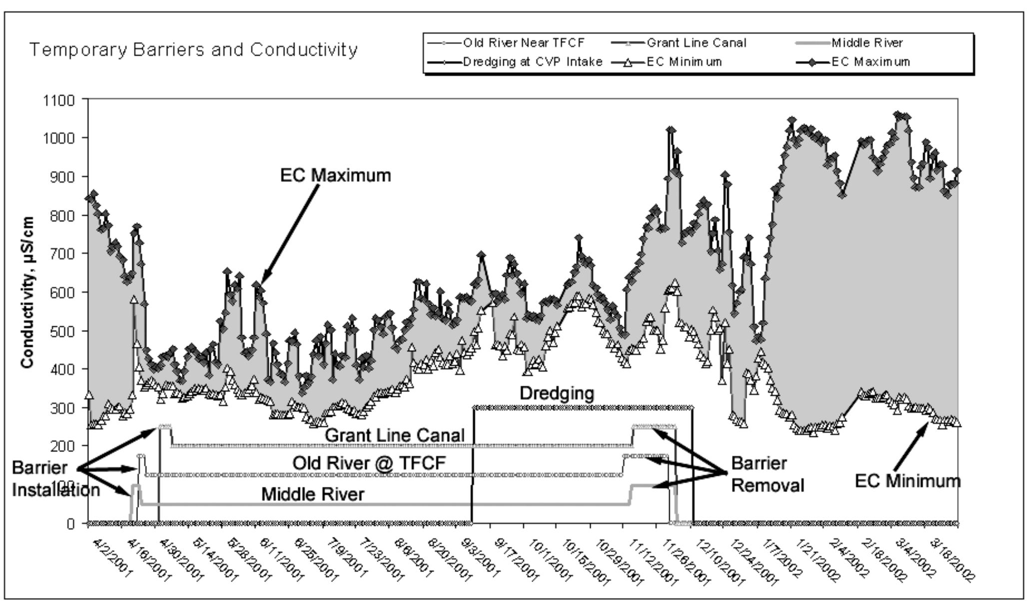
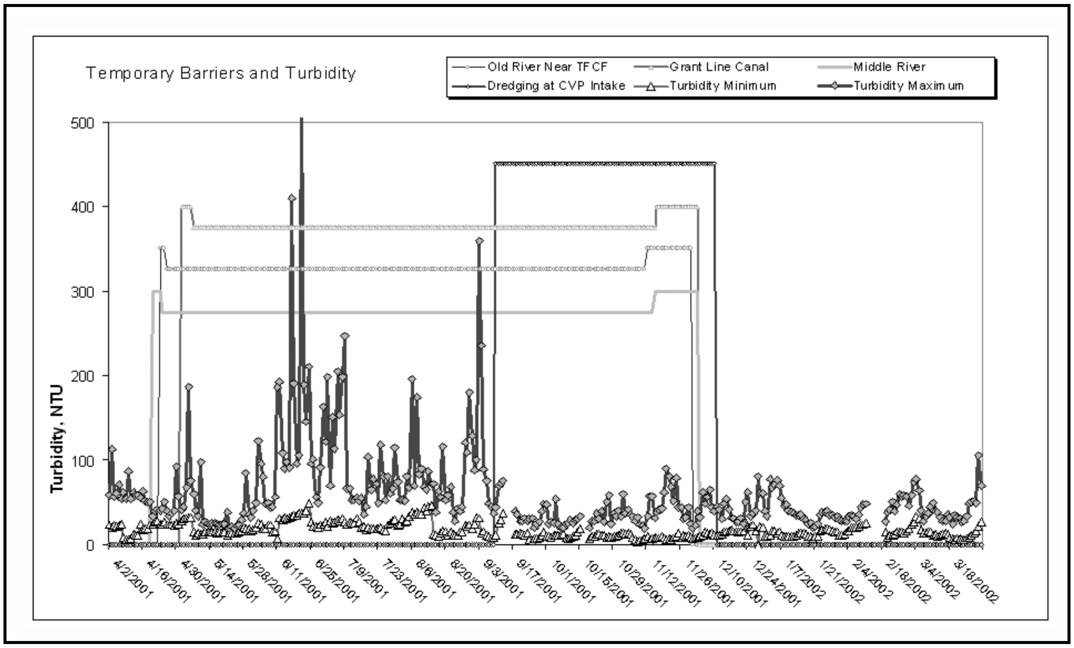


FIGURE 6a.—Effects of local events on dissolved oxygen in milligrams per liter (top) and conductivity in microsiemens per centimeter (bottom).



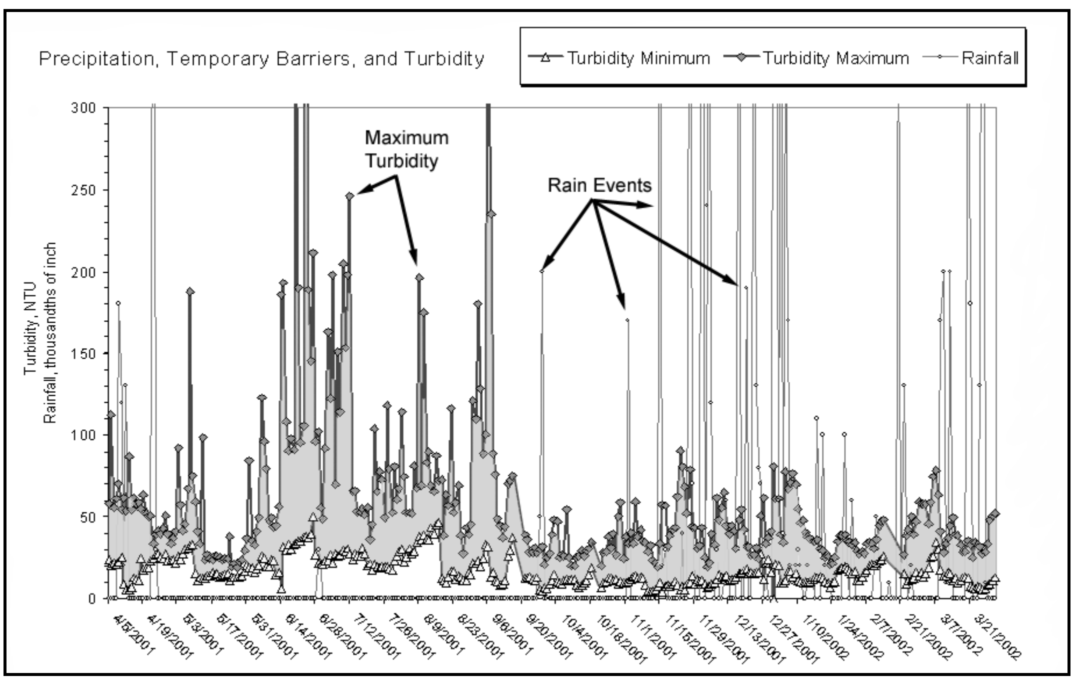


FIGURE 6b.—Turbidity in NTU with temporary barriers schedule (top) and precipitation events (below).

productivity associated with the agricultural season and higher water temperatures. The lack of response associated with nearby channel dredging may be an artifact of the position of the Hydrolab probe—on the north side of the inflow channel—and the potential for incompletely mixed sediment plumes traversing the center of the channel. The bottom graph in figure 6b also shows that precipitation events do not appear to show spikes in turbidity as were observed during a large October 2000 rainfall event in last year's data (Craft et al. 2002). Perhaps there is a threshold storm intensity and duration before a rain event produces a turbidity spike in TFCF waters.

Figure 6c shows total fish salvage (all species) at the TFCF and clear reductions in salvage associated with installation and removal of temporary barriers. This effect is presumably caused by an interruption of normal fish migration patterns and the potential depletion of local fish numbers in the vicinity of the TFCF and the Clifton Court intake. Notably, the fish salvage numbers increase abruptly as soon as the temporary barriers are breached.

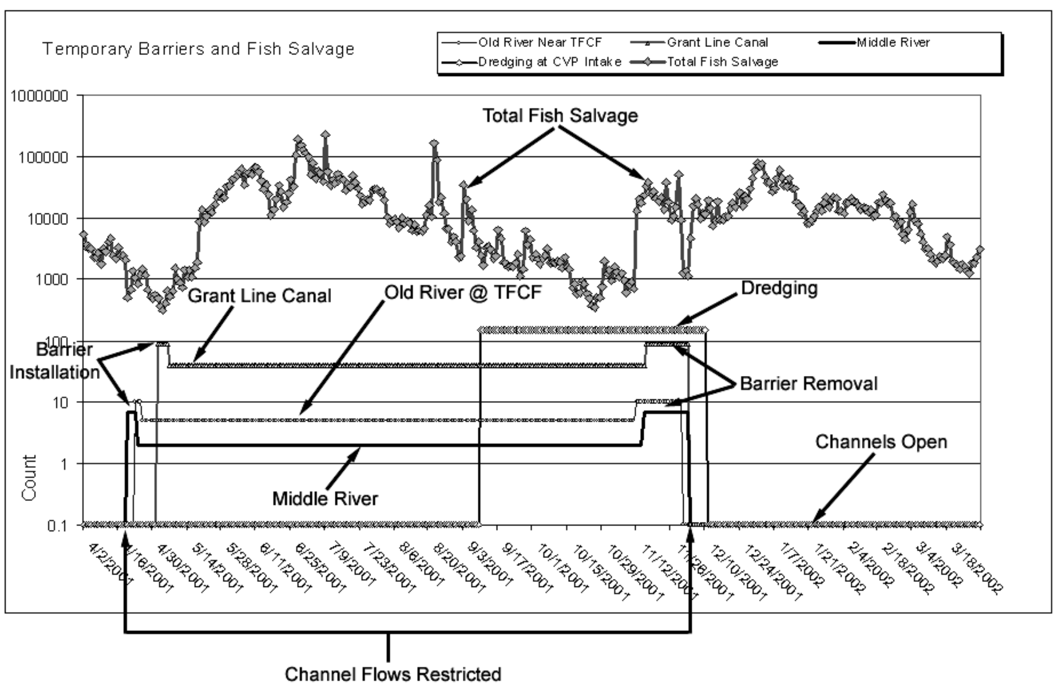


FIGURE 6c.—Total fish salvage at the Tracy Fish Collection Facility with temporary barrier schedules.

Diel factors would be expected to influence chemistry and biological responses in any natural surface water system; however, any diel effect for a water quality variable would have to first account for shifting tidal variation seen throughout the month. While these relationships are important, a more sophisticated and detailed statistical analysis of the data is beyond the scope of this report.

CONCLUSIONS

The second year of reliable water quality data at the TFCF provides an interesting comparison to year one data. The year two T, DO, and EC follow similar seasonal patterns that are consistent with snowmelt runoff and Central Valley watershed processes, and the EC data again suggest that the South Delta temporary barriers have a significant influence on maximum EC observed at the TFCF. It also appears that installation and removal of temporary barriers reduces TFCF fish salvage numbers. Neither year's pH data shows any obvious or consistent response to factors that influence T, DO, Eh, and EC. The second year DO suggests an improvement, with DO below the EPA recommended water quality criteria of 5.0 mg/L (Environmental Protection Agency 1976) only 0.05 percent of the time (compared to 2.9 percent during the previous year). Turbidity spikes were not clearly associated with rainfall events or temporary barriers, however, highest turbidity was observed when barriers were in place.

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Appendix 1

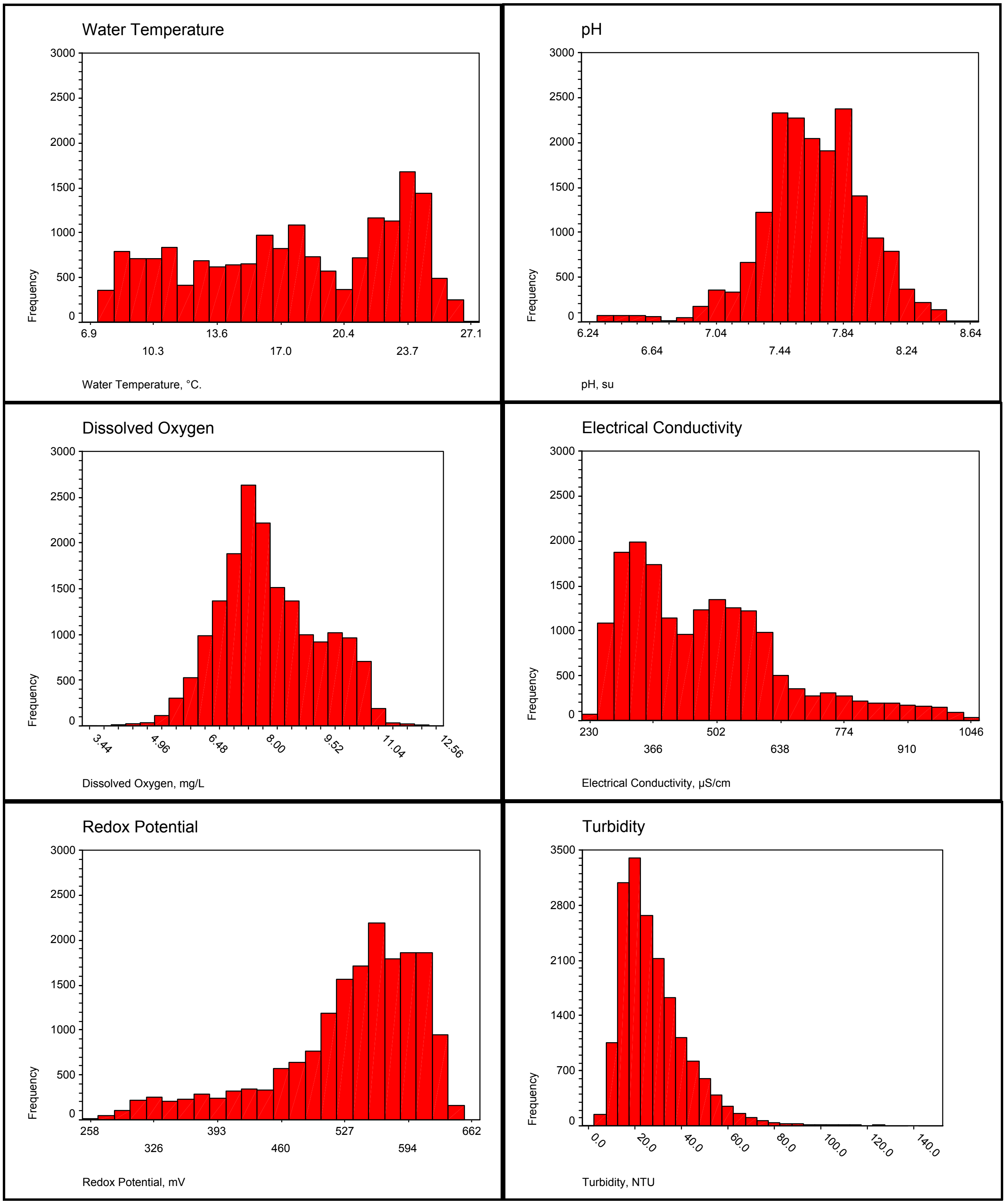

FIGURE A1-1.—Histograms of water quality data collected at the TFCF April 1, 2001, through March 31, 2002.

TABLE A1-1.—Percentile values, by month, for water quality data measured at the TFCF from April 1, 2002, through March 31, 2002

		T, ⁄C	EC, :S/cm	Percent DO Sat	DO, mg/L	pH, s.u.	Eh, mV	Turbidity, NTU
APRIL	**Valid**	1342	1342	1342	1342	1342	1342	1342
	Missing	15	15	15	15	15	15	15
Percentiles	**0.1**	14.0	255	57.6	5.37	7.43	253	5.7
	0.5	14.1	257	62.8	5.86	7.46	265	9.0
	1	14.2	259	65.0	6.03	7.47	269	11.3
	2	14.2	264	67.8	6.43	7.49	278	13.9
	3	14.3	266	69.6	6.55	7.50	285	16.6
	4	14.3	271	70.7	6.65	7.53	289	19.5
	5	14.4	274	71.4	6.76	7.54	298	21.1
	6	14.4	279	72.2	6.87	7.56	301	21.8
	7	14.5	282	72.9	6.97	7.57	305	22.3
	8	14.5	285	73.6	7.03	7.58	310	23.0
	9	14.5	288	74.1	7.07	7.60	314	23.2
	10	14.6	292	74.8	7.15	7.61	319	23.6
	20	14.9	314	80.1	7.63	7.70	372	26.0
	30	15.3	358	83.7	8.08	7.75	411	27.9
	40	15.9	377	86.0	8.45	7.77	438	29.4
	50	16.2	400	87.8	8.66	7.79	459	30.9
	60	16.5	433	89.4	8.92	7.81	473	32.5
	70	16.8	547	90.9	9.06	7.86	490	34.3
	80	18.2	639	93.5	9.30	7.93	509	37.4
	90	19.0	702	99.2	9.86	8.05	534	43.8
	91	19.0	707	99.7	9.93	8.06	538	44.9
	92	19.1	714	101	10.0	8.07	542	45.4
	93	19.2	719	102	10.1	8.08	547	46.8
	94	19.3	734	103	10.2	8.09	550	47.8
	95	19.4	745	104	10.2	8.12	555	49.1
	96	19.5	763	105	10.4	8.14	558	50.7
	97	19.6	780	107	10.5	8.15	563	52.1
	98	19.8	798	108	10.7	8.17	565	54.6
	99	20.0	822	109	10.9	8.21	569	58.2
	99.5	20.1	839	112	11.0	8.24	583	67.7
	99.9	20.4	853	115	11.1	8.26	593	105.4

Table A1-1 - Continued		T, ⁄C	EC, :S/cm	Percent DO Sat	DO, mg/L	pH, s.u.	Eh, mV	Turbidity, NTU
MAY	**Valid**	1473	1473	1473	1473	1473	1473	1472
	Missing	13	13	13	13	13	13	14
Percentiles	**0.1**	17.7	318	40.2	3.51	7.10	263	11.2
	0.5	17.8	330	52.9	4.70	7.16	275	12.3
	1	17.9	331	56.4	4.94	7.18	290	13.1
	2	18.0	332	59.3	5.21	7.19	310	13.7
	3	18.1	333	60.6	5.30	7.21	335	14.1
	4	18.2	333	61.4	5.39	7.23	356	14.2
	5	18.3	334	62.2	5.45	7.24	368	14.4
	6	18.4	334	62.6	5.54	7.26	376	14.7
	7	18.5	335	63.1	5.58	7.28	384	14.8
	8	18.7	335	63.7	5.63	7.29	393	15.0
	9	18.8	336	64.2	5.65	7.30	399	15.1
	10	18.9	336	64.6	5.68	7.31	405	15.2
	20	20.1	340	67.7	5.95	7.36	448	16.4
	30	21.1	349	69.4	6.12	7.41	488	17.5
	40	21.6	356	70.9	6.28	7.45	514	18.5
	50	22.0	361	72.5	6.43	7.51	543	19.7
	60	22.4	368	74.2	6.53	7.55	572	21.3
	70	22.8	379	76.4	6.73	7.59	597	24.6
	80	23.6	399	78.4	6.99	7.63	606	32.0
	90	24.0	431	81.7	7.38	7.69	619	39.0
	91	24.1	435	82.0	7.41	7.69	621	40.0
	92	24.2	439	82.4	7.43	7.70	623	41.0
	93	24.2	445	82.7	7.50	7.71	624	41.9
	94	24.3	451	83.2	7.55	7.72	627	43.2
	95	24.3	463	83.7	7.63	7.72	628	44.4
	96	24.4	478	84.1	7.69	7.73	629	45.7
	97	24.5	502	84.9	7.76	7.74	630	47.4
	98	24.6	526	86.9	7.84	7.77	632	51.6
	99	24.7	566	90.4	7.99	7.79	634	58.0
	99.5	24.8	593	94.3	8.13	7.81	635	69.5
	99.9	24.9	647	100	8.47	7.87	637	184.8

Table A1-1 - Continued		T, ⁄C	EC, :S/cm	Percent DO Sat	DO, mg/L	pH, s.u.	Eh, mV	Turbidity, NTU
JUNE	**Valid**	1435	1434	1435	1435	1435	1435	1427
	Missing	5	6	5	5	5	5	13
Percentiles	**0.1**	20.8	279	46.2	4.01	6.84	287	6.5
	0.5	20.8	281	63.7	5.56	6.89	295	8.5
	1	20.9	282	68.6	5.78	6.91	305	15.2
	2	21.1	283	71.9	6.08	6.96	317	19.5
	3	21.4	284	73.8	6.20	6.98	335	20.6
	4	21.5	284	74.8	6.32	7.03	343	21.4
	5	21.6	285	75.5	6.40	7.10	349	22.5
	6	21.6	286	76.1	6.45	7.15	353	23.3
	7	21.7	286	76.5	6.49	7.17	358	24.0
	8	21.7	287	77.0	6.52	7.18	362	24.7
	9	21.7	288	77.4	6.54	7.20	365	25.3
	10	21.8	288	77.8	6.57	7.21	366	25.7
	20	22.0	303	80.3	6.70	7.31	386	29.8
	30	22.3	316	81.6	6.81	7.39	467	33.5
	40	22.8	329	83.2	6.97	7.45	546	37.0
	50	23.3	339	84.8	7.19	7.49	569	41.4
	60	23.7	350	86.7	7.41	7.53	582	45.9
	70	24.2	368	88.4	7.58	7.58	598	51.7
	80	24.7	390	90.2	7.76	7.64	607	59.6
	90	25.4	441	94.3	8.15	7.73	616	73.7
	91	25.5	448	95.0	8.18	7.74	617	75.7
	92	25.6	459	95.5	8.24	7.75	618	79.0
	93	25.6	469	95.9	8.32	7.76	619	81.8
	94	25.7	480	96.5	8.37	7.78	620	84.0
	95	25.8	498	97.0	8.44	7.83	621	88.2
	96	25.8	527	98.0	8.51	7.88	623	91.8
	97	25.9	546	98.8	8.60	7.91	624	97.8
	98	26.0	564	100.0	8.67	7.98	628	110.2
	99	26.1	589	101.0	8.84	8.01	631	131.1
	99.5	26.2	609	102.2	8.96	8.17	634	182.4
	99.9	26.6	637	105.6	9.24	8.30	636	475.7

Table A1-1 - Continued		T, ⁄C	EC, :S/cm	Percent DO Sat	DO, mg/L	pH, s.u.	Eh, mV	Turbidity, NTU
JULY	**Valid**	1471	1470	1471	1471	1471	1471	1463
	Missing	17	18	17	17	17	17	25
Percentiles	**0.1**	21.8	259	74.3	5.92	6.81	447	17.0
	0.5	21.9	261	76.1	6.09	6.87	460	18.1
	1	22.0	262	77.2	6.22	6.90	473	18.8
	2	22.3	265	78.1	6.37	6.99	482	19.8
	3	22.5	267	78.8	6.42	7.14	491	20.2
	4	22.6	270	79.3	6.47	7.17	494	21.1
	5	22.6	271	79.7	6.52	7.19	497	21.6
	6	22.6	272	80.1	6.59	7.20	499	22.3
	7	22.7	274	80.5	6.62	7.23	500	22.9
	8	22.7	276	80.8	6.66	7.25	503	23.4
	9	22.7	277	81.3	6.69	7.27	505	23.7
	10	22.7	278	81.7	6.71	7.32	506	24.2
	20	23.1	290	84.2	6.96	7.47	520	28.1
	30	23.5	303	85.9	7.15	7.53	528	30.7
	40	23.9	309	87.8	7.34	7.58	536	33.3
	50	24.3	314	89.1	7.51	7.65	542	35.5
	60	24.6	322	90.5	7.63	7.71	552	38.1
	70	24.9	337	92.0	7.75	7.84	566	40.9
	80	25.6	357	93.5	7.88	7.94	579	44.7
	90	26.1	385	95.5	8.04	8.07	595	51.6
	91	26.1	392	95.7	8.06	8.09	597	52.6
	92	26.1	396	95.8	8.08	8.11	599	54.2
	93	26.2	401	96.0	8.10	8.13	601	56.4
	94	26.2	406	96.4	8.13	8.14	604	58.4
	95	26.3	412	96.9	8.16	8.15	606	60.9
	96	26.3	421	97.3	8.24	8.16	607	65.1
	97	26.4	438	97.9	8.31	8.17	613	69.4
	98	26.4	466	99.0	8.45	8.19	617	79.0
	99	26.7	498	99.9	8.58	8.22	629	119.5
	99.5	26.8	509	100.9	8.66	8.24	634	157.7
	99.9	27.1	531	102.7	8.80	8.26	640	226.8

Table A1-1 - Continued		***T, ⁄C***	***EC, :S/cm***	***Percent DO Sat***	***DO, mg/L***	***pH, s.u.***	***Eh, mV***	***Turbidity, NTU***
AUGUST	***Valid***	1479	1480	1481	1481	1481	1484	1473
	Missing	9	8	7	7	7	4	15
Percentiles	***0.1***	22.4	336	62.3	5.29	7.31	438	9.9
	0.5	22.5	340	63.4	5.38	7.33	488	11.3
	1	22.6	343	64.6	5.49	7.36	497	11.8
	2	22.6	352	66.6	5.64	7.40	510	12.6
	3	22.7	355	67.9	5.74	7.42	517	13.6
	4	22.8	358	68.8	5.79	7.43	520	14.6
	5	23.0	362	69.5	5.84	7.45	523	15.3
	6	23.1	367	70.2	5.91	7.46	526	15.8
	7	23.2	372	70.9	5.95	7.47	529	16.4
	8	23.2	375	71.4	6.01	7.49	532	16.9
	9	23.3	377	71.8	6.03	7.50	533	17.5
	10	23.3	380	72.2	6.06	7.50	535	18.1
	20	23.6	404	77.8	6.47	7.65	547	22.5
	30	23.7	426	80.1	6.70	7.78	555	27.2
	40	23.9	446	82.3	6.94	7.91	562	32.1
	50	24.0	465	84.3	7.12	8.02	568	36.5
	60	24.2	483	86.3	7.29	8.07	574	41.7
	70	24.4	497	88.7	7.47	8.11	581	46.6
	80	24.6	511	91.1	7.66	8.14	591	51.1
	90	24.9	528	93.4	7.81	8.17	606	55.9
	91	25.0	530	93.7	7.82	8.18	607	57.1
	92	25.0	531	94.0	7.85	8.18	609	58.5
	93	25.0	534	94.3	7.87	8.19	612	60.2
	94	25.1	536	94.6	7.90	8.20	616	61.3
	95	25.1	539	95.1	7.93	8.21	619	62.7
	96	25.1	542	95.5	7.97	8.22	621	64.6
	97	25.2	547	95.9	8.01	8.23	626	67.8
	98	25.3	553	96.7	8.07	8.24	630	70.4
	99	25.4	567	98.0	8.17	8.27	637	87.1
	99.5	25.5	582	98.8	8.26	8.33	645	113.9
	99.9	25.6	626	103.3	8.74	8.45	653	188.4

Table A1-1 - Continued		T, ⁄C	EC, :S/cm	Percent DO Sat	DO, mg/L	pH, s.u.	Eh, mV	Turbidity, NTU
SEPTEMBE	Valid	1175	1184	1184	1184	1188	1189	1176
	Missing	264	255	255	255	251	250	263
Percentiles	0.1	20.0	400	78.0	6.49	7.23	460	4.8
	0.5	20.2	423	78.9	6.63	7.29	476	6.3
	1	20.4	433	79.9	6.75	7.29	489	6.7
	2	20.4	443	81.0	6.81	7.32	511	7.6
	3	20.5	449	81.4	6.88	7.34	515	8.2
	4	20.5	454	81.9	6.92	7.35	519	8.8
	5	20.6	459	82.2	6.98	7.36	522	9.6
	6	20.8	463	82.6	7.05	7.36	525	10.5
	7	20.9	467	82.9	7.08	7.37	528	10.9
	8	20.9	470	83.2	7.13	7.37	530	11.3
	9	21.0	473	83.7	7.16	7.38	532	11.7
	10	21.0	475	84.0	7.19	7.39	536	12.0
	20	21.4	499	85.9	7.35	7.45	550	14.2
	30	21.8	525	87.0	7.48	7.53	560	16.3
	40	22.2	546	87.9	7.60	7.63	567	18.6
	50	22.5	558	88.9	7.69	7.67	573	22.1
	60	23.0	569	89.8	7.77	7.74	580	26.2
	70	23.5	579	90.8	7.87	7.83	588	31.8
	80	24.0	592	91.9	7.98	7.92	595	40.3
	90	24.4	613	93.5	8.10	7.99	604	50.2
	91	24.5	615	93.7	8.12	7.99	606	51.6
	92	24.5	618	94.0	8.13	8.00	607	54.5
	93	24.6	621	94.3	8.14	8.01	608	56.5
	94	24.7	622	94.7	8.16	8.02	610	57.5
	95	24.7	626	94.9	8.19	8.03	611	60.4
	96	24.8	628	95.3	8.22	8.05	613	63.6
	97	24.8	634	95.7	8.25	8.07	616	67.3
	98	24.9	643	96.2	8.30	8.09	621	71.1
	99	24.9	655	97.5	8.35	8.14	633	87.4
	99.5	25.0	667	98.3	8.41	8.26	637	118.0
	99.9	25.0	694	99.4	8.53	8.39	643	337.5

Table A1-1 - Continued		T, ⁄C	EC, :S/cm	Percent DO Sat	DO, mg/L	pH, s.u.	Eh, mV	Turbidity, NTU
OCTOBER	Valid	1282	1285	1285	1283	1285	1286	1284
	Missing	205	202	202	204	202	201	203
Percentiles	0.1	17.4	392	73.1	6.58	6.93	380	6.6
	0.5	17.5	404	74.6	6.81	6.95	398	7.4
	1	17.5	412	75.3	6.91	6.97	409	8.2
	2	17.6	427	76.5	6.99	6.98	437	9.1
	3	17.7	441	77.1	7.07	6.99	454	9.6
	4	17.7	453	77.8	7.12	6.99	463	10.1
	5	17.8	460	78.1	7.14	7.00	476	10.3
	6	17.8	464	78.6	7.18	7.01	486	10.4
	7	17.8	468	79.1	7.21	7.02	495	10.7
	8	17.8	470	79.6	7.24	7.02	501	11.0
	9	17.9	474	79.9	7.27	7.03	505	11.2
	10	17.9	478	80.1	7.29	7.03	508	11.4
	20	18.0	498	81.5	7.47	7.26	535	12.7
	30	18.4	517	82.7	7.59	7.36	557	13.8
	40	19.1	541	83.7	7.66	7.40	579	14.8
	50	19.4	563	84.4	7.74	7.43	608	15.8
	60	19.8	580	85.3	7.81	7.57	615	16.8
	70	20.2	596	86.1	7.89	7.69	620	18.2
	80	20.8	611	86.9	7.99	7.79	626	20.2
	90	21.6	624	88.4	8.14	7.82	633	23.2
	91	21.6	625	88.5	8.17	7.82	634	24.0
	92	21.6	628	88.8	8.21	7.82	635	24.9
	93	21.7	630	89.0	8.25	7.83	636	25.6
	94	21.7	633	89.2	8.27	7.83	636	26.1
	95	21.8	638	89.4	8.32	7.84	637	26.8
	96	21.8	642	89.9	8.36	7.84	639	28.0
	97	21.9	650	90.1	8.39	7.84	642	29.8
	98	22.0	661	91.3	8.43	7.85	645	33.7
	99	22.1	676	92.5	8.48	7.87	647	40.5
	99.5	22.1	693	95.4	8.51	7.88	649	45.5
	99.9	22.2	738	98.0	8.55	7.89	651	58.4

Table A1-1 - Continued		T, ⁄C	EC, :S/cm	Percent DO Sat	DO, mg/L	pH, s.u.	Eh, mV	Turbidity, NTU
NOVEMBER	**Valid**	1433	1431	1430	1430	1431	1431	1429
	Missing	7	9	10	10	9	9	11
Percentiles	**0.1**	10.5	414	67.6	6.73	7.29	454	3.9
	0.5	10.7	424	68.1	6.80	7.33	466	4.8
	1	10.9	432	68.6	6.83	7.33	478	5.2
	2	11.0	448	70.0	7.02	7.35	491	6.0
	3	11.3	452	70.8	7.11	7.36	499	6.5
	4	11.5	458	72.7	7.26	7.38	504	7.1
	5	11.6	460	74.5	7.47	7.38	509	7.5
	6	11.6	463	76.0	7.58	7.38	512	7.9
	7	12.0	466	77.2	7.72	7.39	516	8.2
	8	12.2	467	78.1	7.81	7.40	520	8.5
	9	12.4	469	78.8	7.86	7.40	522	8.9
	10	12.5	471	79.2	7.90	7.41	526	9.2
	20	14.2	488	80.9	8.08	7.45	556	11.7
	30	15.3	504	82.4	8.22	7.47	574	13.8
	40	15.5	518	83.8	8.31	7.50	587	15.8
	50	15.8	536	85.5	8.44	7.55	593	17.5
	60	16.0	553	86.4	8.57	7.62	604	19.2
	70	16.4	568	87.3	8.67	7.65	609	21.6
	80	16.9	591	88.6	8.78	7.72	616	25.4
	90	17.4	690	89.9	8.98	7.78	621	33.0
	91	17.4	709	90.1	9.01	7.79	622	34.1
	92	17.5	727	90.3	9.05	7.79	622	35.7
	93	17.5	739	90.5	9.19	7.80	623	37.1
	94	17.5	744	90.7	9.27	7.82	623	38.8
	95	17.5	753	90.9	9.37	7.85	624	42.9
	96	17.5	762	91.1	9.49	7.90	624	45.4
	97	17.6	769	91.3	9.57	7.93	625	48.7
	98	17.6	790	91.7	9.63	7.95	626	53.4
	99	17.7	805	92.0	9.72	7.96	628	59.9
	99.5	17.7	811	92.6	9.75	7.98	629	65.4
	99.9	17.8	873	93.4	9.84	8.05	631	86.3

Table A1-1 - Continued		T, ⁄C	EC, ∶S/cm	Percent DO Sat	DO, mg/L	pH, s.u.	Eh, mV	Turbidity, NTU
DECEMBER	**Valid**	1468	1465	129	1465	1465	1465	1463
	Missing	19	22	1358	22	22	22	24
Percentiles	**0.1**	7.7	263	80.2	6.75	7.34	267	0.0
	0.5	7.7	265	80.2	6.97	7.45	276	6.1
	1	7.8	271	80.4	7.45	7.46	285	8.3
	2	8.0	281	80.9	7.76	7.48	294	9.9
	3	8.0	289	81.1	7.86	7.49	300	10.9
	4	8.1	297	81.4	7.98	7.51	303	11.7
	5	8.1	305	82.0	8.07	7.51	305	12.2
	6	8.7	324	82.2	8.30	7.52	308	12.5
	7	8.8	369	82.6	8.48	7.53	310	12.8
	8	8.8	380	83.1	8.58	7.54	312	13.2
	9	8.9	402	83.3	8.61	7.54	312	13.4
	10	8.9	423	83.7	8.67	7.54	314	13.8
	20	9.1	488	84.6	9.30	7.63	327	16.1
	30	9.6	528	85.2	9.61	7.81	342	18.1
	40	9.7	558	85.6	9.91	7.83	437	20.1
	50	10.0	587	86.6	10.10	7.85	494	22.1
	60	10.3	608	87.6	10.22	7.87	546	24.2
	70	10.6	644	88.4	10.39	7.89	571	27.0
	80	10.8	717	90.2	10.52	7.93	582	30.1
	90	11.0	764	91.4	10.76	8.06	588	34.9
	91	11.1	768	91.8	10.82	8.10	589	35.4
	92	11.1	775	92.0	10.85	8.12	590	35.7
	93	11.2	788	92.3	10.91	8.14	590	36.4
	94	11.2	803	92.3	10.97	8.16	591	37.3
	95	11.3	821	92.3	11.05	8.19	593	38.8
	96	11.4	828	92.3	11.11	8.22	595	39.8
	97	11.5	845	92.4	11.16	8.26	596	42.0
	98	11.7	878	92.5	11.24	8.30	597	44.4
	99	12.3	938	93.0	11.35	8.34	599	51.1
	99.5	12.5	983	93.2	11.55	8.37	601	56.7
	99.9	12.8	1019	93.2	11.66	8.41	602	73.4

Table A1-1 - Continued		T, ⁄C	EC, :S/cm	Percent DO Sat	DO, mg/L	pH, s.u.	Eh, mV	Turbidity, NTU
JANUARY	**Valid**	1473	1473	1389	1473	1473	1473	1473
	Missing	15	15	99	15	15	15	15
Percentiles	**0.1**	7.4	238	61.4	6.68	6.85	308	7.2
	0.5	7.5	241	62.0	6.78	6.87	327	9.6
	1	7.6	242	62.7	6.85	6.88	346	10.2
	2	7.7	247	63.9	6.96	6.90	354	10.6
	3	7.8	250	64.6	7.07	6.95	364	11.1
	4	7.9	253	65.3	7.14	6.96	380	11.3
	5	8.0	255	65.9	7.18	6.97	387	11.6
	6	8.0	257	66.3	7.23	6.98	481	12.0
	7	8.1	261	66.7	7.28	6.99	494	12.4
	8	8.1	264	67.1	7.34	6.99	499	12.6
	9	8.1	266	67.6	7.37	7.00	503	13.0
	10	8.2	270	68.0	7.42	7.01	505	13.2
	20	8.3	325	70.5	7.63	7.10	516	15.6
	30	8.5	391	72.2	7.86	7.19	527	17.4
	40	8.9	424	74.2	8.18	7.28	534	18.9
	50	9.8	456	76.6	8.60	7.37	544	20.8
	60	10.6	486	80.5	9.07	7.45	572	22.8
	70	10.9	606	83.8	9.74	7.54	597	25.0
	80	11.1	722	85.3	9.94	7.65	607	28.2
	90	11.5	892	88.5	10.32	7.79	619	36.7
	91	11.5	918	88.7	10.40	7.80	620	38.6
	92	11.5	930	88.8	10.45	7.81	623	39.9
	93	11.6	953	89.1	10.48	7.82	626	41.5
	94	11.7	970	89.4	10.52	7.83	629	44.6
	95	11.7	984	89.6	10.56	7.84	633	46.5
	96	11.9	995	89.9	10.58	7.87	638	48.3
	97	11.9	1002	90.1	10.61	7.88	641	52.8
	98	12.3	1013	90.3	10.64	7.90	642	57.5
	99	12.4	1019	90.6	10.72	7.96	644	65.5
	99.5	12.7	1025	91.0	10.76	8.01	646	69.2
	99.9	12.8	1046	91.5	10.79	8.09	648	76.9

Table A1-1 - Continued		T, ⁄C	EC, :S/cm	Percent DO Sat	DO, mg/L	pH, s.u.	Eh, mV	Turbidity, NTU
FEBRUARY	**Valid**	950	950	950	950	950	950	950
	Missing	394	394	394	394	394	394	394
Percentiles	**0.1**	7.5	241	77.3	7.82	6.29	443	8.9
	0.5	7.6	250	78.6	7.94	6.30	463	11.6
	1	7.6	252	79.1	7.98	6.31	472	12.4
	2	7.7	255	79.8	8.07	6.33	475	12.8
	3	7.8	256	80.1	8.11	6.34	480	13.5
	4	7.8	257	80.6	8.15	6.35	484	14.2
	5	7.9	258	80.9	8.21	6.36	485	14.7
	6	7.9	259	81.2	8.29	6.37	490	15.3
	7	7.9	260	81.5	8.32	6.38	492	15.6
	8	8.0	261	81.8	8.38	6.39	494	15.9
	9	8.0	262	82.2	8.44	6.40	496	16.4
	10	8.1	263	82.5	8.48	6.41	499	16.7
	20	8.5	288	85.0	8.88	6.56	520	19.0
	30	9.0	336	86.4	9.13	7.16	538	20.8
	40	9.4	355	87.1	9.54	7.30	547	22.5
	50	10.6	440	87.9	9.95	7.74	553	24.1
	60	12.0	618	88.6	10.08	7.80	558	25.5
	70	12.6	783	89.4	10.22	7.84	563	27.3
	80	13.3	879	90.2	10.49	7.88	567	29.5
	90	14.1	933	91.6	10.66	7.92	573	33.6
	91	14.2	941	91.9	10.68	7.92	574	34.1
	92	14.3	945	92.1	10.69	7.93	575	34.6
	93	14.4	950	92.5	10.70	7.94	575	35.1
	94	14.5	956	92.8	10.72	7.95	576	36.0
	95	14.6	970	93.2	10.73	7.96	577	37.2
	96	14.7	977	93.6	10.75	7.97	578	39.2
	97	14.8	982	93.9	10.77	7.99	580	40.7
	98	15.0	988	94.2	10.78	8.02	584	43.0
	99	15.2	993	94.5	10.84	8.04	590	48.7
	99.5	15.3	1001	94.8	10.89	8.05	602	57.1
	99.9	15.5	1009	95.5	10.90	8.07	606	59.2

Table A1-1 - Continued		***T, ⁄C***	***EC, :S/cm***	***Percent DO Sat***	***DO, mg/L***	***pH, s.u.***	***Eh, mV***	***Turbidity, NTU***
MARCH	***Valid***	1476	1476	1476	1476	1476	1476	1476
	Missing	11	11	11	11	11	11	11
Percentiles	***0.1***	11.3	257	79.2	8.06	7.29	372	5.6
	0.5	11.4	263	80.3	8.19	7.31	385	6.2
	1	11.5	266	80.7	8.24	7.32	391	6.7
	2	11.8	270	81.6	8.38	7.34	402	7.4
	3	11.9	272	82.1	8.45	7.35	407	7.8
	4	12.0	274	82.5	8.52	7.37	410	8.2
	5	12.1	275	82.9	8.58	7.38	414	8.5
	6	12.2	277	83.3	8.66	7.39	418	9.0
	7	12.2	279	83.6	8.71	7.41	420	9.5
	8	12.3	281	83.9	8.74	7.41	423	9.9
	9	12.4	283	84.2	8.76	7.43	428	10.2
	10	12.4	288	84.5	8.80	7.45	430	10.7
	20	12.8	312	86.2	8.97	7.75	454	14.1
	30	13.0	332	88.1	9.15	7.83	472	16.5
	40	13.2	354	89.7	9.38	7.92	497	18.2
	50	13.5	439	91.6	9.60	7.96	515	20.7
	60	13.7	635	95.9	9.78	8.01	528	23.8
	70	14.1	805	98.4	9.97	8.09	539	28.5
	80	14.6	874	99.7	10.27	8.25	555	35.4
	90	15.8	944	102.2	10.61	8.37	566	43.6
	91	15.9	951	102.8	10.69	8.37	566	45.1
	92	16.1	959	103.2	10.74	8.38	567	46.1
	93	16.3	963	103.7	10.77	8.39	569	47.6
	94	16.4	972	104.2	10.81	8.40	571	48.8
	95	16.7	982	105.4	10.85	8.40	574	50.2
	96	17.0	989	106.2	10.89	8.41	589	52.1
	97	17.4	1005	107.8	10.94	8.42	595	55.0
	98	17.8	1018	109.4	10.99	8.43	603	59.2
	99	18.5	1049	115.2	11.12	8.44	610	65.3
	99.5	19.1	1053	117.0	11.21	8.45	615	73.0
	99.9	19.5	1060	118.5	11.34	8.47	618	92.5

TABLE A1-2.—Rank summaries and percentiles for water quality variables measured at the TFCF from April 2000 through March 2002. Year 1 includes April 1, 2000, through March 31, 2001. Year 2 includes April 1, 2001, through March 31, 2002

		Temperature, /C		***Conductivity, :S/cm***		***DO, mg/L***		***pH, su***		***Turbidity, NTU***	
		Year 1	***Year 2***	***Year 1***	***Year 2***	***Year 1***	***Year 2***	***Year 1***	***Year 2***	***Year 1***	***Year 2***
APRIL	***Valid***	1,303	1,423	1,303	1,423	1,306	1,423	1,306	1,423	1,306	1,423
	Missing	137	15	137	15	134	15	134	15	134	15
Percentiles	***0.1***	16.4	14.0	239	255	5.72	5.39	7.03	7.43	6.4	5.7
	0.5	16.5	14.2	242	257	6.07	5.89	7.24	7.46	7.6	9.1
	1	16.5	14.2	245	259	6.42	6.04	7.30	7.47	8.9	11.5
	5	16.8	14.4	262	275	7.38	6.80	7.47	7.54	10.9	21.1
	25	17.4	15.1	290	324	8.28	7.91	7.71	7.72	15.4	26.7
Median	***50***	**17.9**	**16.3**	**359**	**399**	**8.77**	**8.74**	**8.02**	**7.79**	**21.9**	**30.8**
	75	18.4	17.7	477	601	9.33	9.19	8.23	7.89	29.7	35.5
	95	18.9	19.3	569	758	9.90	10.2	8.54	8.11	42.8	48.9
	99	19.2	20.0	608	846	10.2	10.8	8.62	8.21	55.3	58.3
	99.5	19.2	20.1	615	921	10.3	11.0	8.63	8.24	60.1	67.8
	99.9	19.5	20.4	634	970	10.3	11.1	8.65	8.26	71.1	328
MAY	***Valid***	1,466	1,473	1,466	1,473	1,466	1,473	1,466	1,473	1,466	1,472
	Missing	22	13	22	13	22	13	22	13	22	14
Percentiles	***0.1***	16.9	17.7	320	318	5.90	3.51	7.35	7.10	11.2	11.2
	0.5	17.1	17.8	324	330	6.23	4.70	7.42	7.16	13.0	12.3
	1	17.3	17.9	330	331	6.35	4.94	7.44	7.18	14.0	13.1
	5	17.5	18.3	342	334	6.74	5.45	7.49	7.24	16.8	14.4
	25	18.2	20.9	362	344	7.24	6.03	7.67	7.39	23.2	17.0
Median	***50***	**19.3**	**22.0**	**403**	**361**	**7.55**	**6.43**	**7.74**	**7.51**	**29.2**	**19.7**
	75	21.5	23.2	462	388	7.81	6.87	7.81	7.61	38.9	28.0
	95	23.3	24.3	498	463	8.32	7.63	7.99	7.72	56.9	44.4
	99	23.9	24.7	519	565	9.03	7.99	8.21	7.79	65.9	58.0
	99.5	24.0	24.8	524	592	9.23	8.13	8.27	7.81	70.1	69.5
	99.9	24.2	24.9	533	647	9.49	8.47	8.32	7.87	173	185

Table A1-2: Continued		Temperature, ⁄C		Conductivity, :S/cm		DO, mg/L		pH, su		Turbidity, NTU	
		Year 1	**Year 2**	**Year 1**	**Year 2**	**Year 1**	**Year 2**	**Year 1**	**Year 2**	**Year 1**	**Year 2**
JUNE	***Valid***	1,165	1,439	1,163	1,438	1,163	1,439	1,163	1,439	1,163	1,431
	Missing	275	5	277	6	277	5	277	5	277	13
Percentiles	***0.1***	19.6	20.8	243	279	3.85	4.01	7.22	6.84	-	6.5
	0.5	19.7	20.8	249	281	4.56	5.56	7.29	6.89	-	8.5
	1	19.8	20.9	250	282	5.18	5.78	7.32	6.91	0.1	15.2
	5	20.4	21.6	256	285	5.71	6.40	7.45	7.10	8.3	22.5
	25	21.5	22.1	282	311	6.48	6.74	7.67	7.35	25.6	31.7
Median	***50***	**22.6**	**23.3**	**336**	**339**	**6.96**	**7.18**	**7.75**	**7.49**	**34.7**	**41.4**
	75	24.6	24.4	449	376	8.21	7.64	7.82	7.62	44.8	55.9
	95	25.3	25.8	525	498	9.12	8.44	7.99	7.83	61.9	88.2
	99	25.6	26.1	561	589	10.2	8.84	8.21	8.01	71.2	131.1
	99.5	25.8	26.2	581	609	10.5	8.95	8.27	8.17	74.2	181.9
	99.9	26.0	26.6	666	637	10.9	9.23	8.32	8.30	263	475
JULY	***Valid***	1,063	1,470	1,070	1,470	1,065	1,470	1,070	1,470	951	1,462
	Missing	416	18	409	18	414	18	409	18	528	26
Percentiles	***0.1***	22.0	21.8	216	259	4.52	5.92	7.31	6.81	0.1	17.0
	0.5	22.1	21.9	217	261	5.22	6.09	7.32	6.87	0.3	18.1
	1	22.1	22.1	218	262	5.42	6.22	7.34	6.90	0.7	18.8
	5	22.6	22.6	225	271	6.05	6.52	7.46	7.19	4.4	21.6
	25	23.1	23.3	240	296	6.72	7.05	7.59	7.50	18.4	29.5
Median	***50***	**23.6**	**24.3**	**247**	**314**	**7.17**	**7.51**	**7.70**	**7.65**	**23.5**	**35.5**
	75	24.3	25.2	291	346	7.52	7.81	7.84	7.88	31.1	42.4
	95	25.3	26.3	476	412	7.90	8.16	7.97	8.15	56.1	61.0
	99	25.9	26.7	565	498	8.08	8.58	8.03	8.22	85.5	120
	99.5	26.0	26.8	620	509	8.33	8.66	8.04	8.24	136	158
	99.9	26.2	27.1	669	531	8.66	8.80	8.06	8.26	232	227

Table A1-2: Continued		***Temperature, /C***		***Conductivity, :S/cm***		***DO, mg/L***		***pH, su***		***Turbidity, NTU***	
		Year 1	***Year 2***	***Year 1***	***Year 2***	***Year 1***	***Year 2***	***Year 1***	***Year 2***	***Year 1***	***Year 2***
AUGUST	***Valid***	1,462	1,479	1,462	1,480	1,462	1,481	1,462	1,481	1,385	1,473
	Missing	26	9	26	8	26	7	26	7	103	15
Percentiles	***0.1***	21.4	22.4	227	336	3.99	5.29	7.48	7.31	-	9.9
	0.5	21.5	22.5	228	340	4.03	5.38	7.50	7.33	0.4	11.3
	1	21.6	22.6	229	344	4.06	5.49	7.51	7.36	0.8	11.8
	5	22.2	23.0	232	362	4.26	5.84	7.56	7.45	3.8	15.3
	25	23.9	23.7	241	416	4.84	6.60	7.74	7.71	14.4	25.0
Median	***50***	**24.3**	**24.0**	**260**	**466**	**7.27**	**7.12**	**8.00**	**8.02**	**21.3**	**36.5**
	75	24.9	24.5	301	503	7.78	7.56	8.16	8.12	29.8	48.9
	95	26.4	25.1	435	539	8.81	7.93	8.28	8.21	42.9	62.7
	99	26.9	25.4	527	567	9.21	8.17	8.42	8.27	53.4	87.1
	99.5	27.2	25.5	562	583	9.82	8.26	8.44	8.33	57.6	114
	99.9	27.4	25.7	607	626	10.1	8.74	8.53	8.45	119	188
SEPTEMBER	***Valid***	1,385	1,175	1,385	1,184	1,385	1,184	1,385	1,188	1,385	1,176
	Missing	55	264	55	255	55	255	55	251	55	263
Percentiles	***0.1***	20.1	20.0	273	400	6.91	6.49	7.20	7.23	-	4.8
	0.5	20.2	20.3	276	423	7.21	6.63	7.22	7.29	-	6.3
	1	20.2	20.4	278	434	7.37	6.75	7.23	7.29	-	6.7
	5	20.6	20.7	285	459	7.60	6.98	7.28	7.36	2.4	9.6
	25	21.3	21.6	297	513	7.95	7.43	7.50	7.49	22.5	15.1
Median	***50***	**22.0**	**22.5**	**328**	**558**	**8.62**	**7.69**	**7.80**	**7.67**	**32.5**	**22.1**
	75	22.6	23.8	366	583	10.6	7.92	7.95	7.88	38.8	35.9
	95	23.4	24.7	425	626	11.7	8.19	8.21	8.03	47.2	60.4
	99	23.9	24.9	486	655	12.0	8.35	8.37	8.14	57.2	87.4
	99.5	24.0	25.0	505	667	12.2	8.41	8.42	8.26	70.4	118
	99.9	24.1	25.0	533	694	12.4	8.53	8.48	8.39	102	337

Table A1-2: Continued		Temperature, ⁄C		Conductivity, :S/cm		DO, mg/L		pH, su		Turbidity, NTU	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
OCTOBER	***Valid***	1,443	1,282	1,443	1,285	1,443	1,283	1,443	1,285	1,319	1,284
	Missing	32	205	32	202	32	204	32	202	156	203
Percentiles	***0.1***	13.9	17.4	315	392	6.63	6.58	7.33	6.93	-	6.6
	0.5	14.1	17.4	324	403	6.74	6.81	7.38	6.95	-	7.4
	1	14.2	17.5	329	412	6.82	6.91	7.39	6.97	-	8.2
	5	14.7	17.8	346	460	7.30	7.14	7.46	7.00	10.2	10.3
	25	15.7	18.1	381	506	7.70	7.52	7.54	7.31	16.2	13.3
Median	***50***	**18.7**	**19.4**	**417**	**563**	**8.30**	**7.73**	**7.61**	**7.43**	**21.7**	**15.8**
	75	20.4	20.5	452	605	8.67	7.93	7.70	7.75	29.3	19.2
	95	21.9	21.8	504	640	9.28	8.32	7.83	7.83	115	26.8
	99	22.1	22.1	569	681	9.47	8.48	7.93	7.85	288	39.7
	99.5	22.3	22.1	584	693	9.50	8.51	7.96	7.87	381	42.8
	99.9	22.5	22.3	609	738	9.61	8.55	8.02	7.89	547	57.2
NOVEMBER	***Valid***	1401	1433	1401	1431	1401	1430	1401	1431	1397	1429
	Missing	37	7	37	9	37	10	37	9	41	11
Percentiles	***0.1***	10.2	10.5	216	414	5.37	6.73	7.32	7.29	3.2	3.9
	0.5	10.3	10.7	217	424	5.91	6.80	7.41	7.33	3.9	4.8
	1	10.3	10.9	218	431	6.23	6.83	7.43	7.33	5.9	5.2
	5	10.4	11.6	226	460	7.12	7.47	7.47	7.38	8.9	7.5
	25	10.9	14.9	414	496	8.73	8.15	7.53	7.46	13.6	13.0
Median	***50***	**11.8**	**15.8**	**497**	**536**	**9.53**	**8.44**	**7.60**	**7.55**	**19.3**	**17.5**
	75	14.3	16.5	545	579	9.80	8.72	7.73	7.68	32.9	23.2
	95	14.5	17.5	632	752	10.3	9.37	7.96	7.85	132	42.9
	99	14.6	17.7	661	805	10.6	9.72	8.03	7.96	156	59.9
	99.5	14.6	17.7	668	811	10.7	9.75	8.04	7.98	165	65.4
	99.9	15.1	17.8	688	873	10.8	9.84	8.08	8.05	335	86.3

Table A1-2: Continued		Temperature, /C		Conductivity, :S/cm		DO, mg/L		pH, su		Turbidity, NTU	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
DECEMBER	Valid	1,482	1,468	1,480	1,465	1,480	1,463	1,480	1,465	1,480	1,463
	Missing	6	19	8	22	8	24	8	22	8	24
Percentiles	0.1	8.1	7.7	392	263	8.11	6.75	7.12	7.34	3.5	-
	0.5	8.2	7.7	395	265	8.17	6.97	7.13	7.45	4.2	6.1
	1	8.3	7.8	402	271	8.20	7.45	7.14	7.46	4.9	8.3
	5	9.0	8.1	428	305	8.52	8.07	7.16	7.51	5.9	12.2
	25	9.7	9.3	498	514	8.86	9.52	7.37	7.77	9.8	17.3
Median	50	**10.0**	**10.0**	**554**	**587**	**9.04**	**10.1**	**7.49**	**7.85**	**15.8**	**22.1**
	75	10.3	10.7	656	684	10.0	10.5	7.60	7.90	84.0	28.3
	95	11.3	11.3	736	822	10.5	11.1	7.69	8.19	96.5	38.8
	99	11.6	12.3	752	938	10.6	11.4	7.74	8.34	107	51.1
	99.5	11.6	12.5	757	983	10.7	11.6	7.76	8.37	111	56.7
	99.9	11.8	12.8	804	1,019	10.8	11.7	7.81	8.41	121	73.4
JANUARY	Valid	1,137	1,473	1,464	1,473	1,451	1,473	1,155	1,473	1,464	1,473
	Missing	351	15	24	15	37	15	333	15	24	15
Percentiles	0.1	7.3	7.4	422	238	3.38	6.68	6.29	6.85	1.7	7.2
	0.5	7.4	7.5	436	241	3.49	6.78	6.41	6.87	2.2	9.6
	1	7.5	7.7	443	242	3.67	6.85	6.46	6.88	2.4	10.2
	5	7.6	8.0	472	255	5.11	7.18	6.74	6.97	3.2	11.6
	25	7.9	8.4	540	363	9.23	7.74	7.44	7.12	8.7	16.6
Median	50	**8.3**	**9.8**	**635**	**456**	**9.71**	**8.60**	**7.58**	**7.37**	**17.9**	**20.8**
	75	8.6	11.0	732	673	10.4	9.84	7.75	7.58	21.6	26.3
	95	9.2	11.7	851	984	11.1	10.6	8.02	7.84	76.0	46.5
	99	9.6	12.4	958	1,019	11.6	10.7	8.09	7.96	105	65.5
	99.5	9.7	12.7	1,009	1,025	11.9	10.8	8.09	8.01	139	69.2
	99.9	9.9	12.8	1,083	1,046	12.2	10.8	8.10	8.09	550	76.9

Table A1-2: Continued		Temperature, /C		Conductivity, :S/cm		DO, mg/L		pH, su		Turbidity, NTU	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
FEBRUARY	**Valid**	1,332	950	1,332	950	1,332	950	1,332	950	1,332	950
	Missing	12	394	12	394	12	394	12	394	12	394
Percentiles	**0.1**	8.0	7.5	371	241	8.68	7.82	6.82	6.29	13.9	8.9
	0.5	8.0	7.6	374	250	8.79	7.94	6.83	6.30	14.9	11.6
	1	8.0	7.7	377	252	8.82	7.98	6.85	6.31	15.6	12.4
	5	8.2	7.9	383	258	8.96	8.21	6.89	6.36	17.7	14.7
	25	8.8	8.8	417	330	9.40	9.03	7.07	6.65	22.7	20.0
Median	**50**	**9.5**	**10.6**	**464**	**440**	**9.80**	**9.95**	**7.42**	**7.74**	**26.7**	**24.1**
	75	10.3	13.0	691	841	10.2	10.4	7.57	7.85	32.0	28.4
	95	11.7	14.6	976	971	10.6	10.7	7.63	7.96	62.4	37.2
	99	12.1	15.2	1,048	993	10.7	10.8	7.65	8.04	151	48.7
	99.5	12.2	15.3	1,054	1,001	10.7	10.9	7.67	8.05	164	57.1
	99.9	12.4	15.5	1,066	1,009	10.7	10.9	7.68	8.07	248	59.2
MARCH	**Valid**	1,478	1,476	1,475	1,476	1,475	1,476	1,475	1,476	1,475	1,476
	Missing	10	11	13	11	13	11	13	11	13	11
Percentiles	**0.1**	10.4	11.3	307	256	6.03	8.06	6.80	7.29	6.1	5.6
	0.5	10.6	11.4	311	263	6.90	8.19	6.82	7.31	7.6	6.2
	1	10.8	11.5	313	266	6.98	8.24	6.84	7.32	8.4	6.7
	5	11.1	12.1	346	275	7.24	8.58	6.97	7.38	19.4	8.5
	25	12.7	12.9	428	323	7.79	9.04	7.27	7.79	24.3	15.4
Median	**50**	**15.0**	**13.5**	**589**	**439**	**8.16**	**9.60**	**7.36**	**7.96**	**28.6**	**20.7**
	75	17.6	14.3	808	848	9.18	10.2	7.47	8.21	34.3	31.6
	95	18.8	16.7	1,092	982	9.69	10.9	7.74	8.40	48.3	50.2
	99	19.5	18.4	1,150	1,049	9.98	11.1	7.88	8.44	62.6	65.3
	99.5	19.7	19.1	1,173	1,053	10.1	11.2	7.90	8.45	68.9	73.0
	99.9	19.7	19.6	1,219	1,060	10.4	11.3	7.92	8.47	325	92.5

Table A1-2: Continued		Temperature, ⁄C		Conductivity, :S/cm		DO, mg/L		pH, su		Turbidity, NTU	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
ALL DATA	Valid	16,117	16,541	16,444	16,548	16,429	16,545	16,138	16,554	16123	16512
	Missing	1,379	975	1,052	968	1,067	971	1,358	962	1373	1004
Percentiles	0.1	7.47	7.55	217	243	3.70	4.90	6.49	6.32	0.0	5.1
	0.5	7.61	7.80	224	254	4.14	5.44	6.82	6.39	0.0	6.7
	1	7.73	8.00	227	259	4.35	5.64	6.88	6.52	2.1	7.6
	5	8.36	8.70	241	282	6.25	6.24	7.13	7.08	6.6	11.4
	25	10.9	12.8	327	348	7.55	7.28	7.49	7.45	17.0	17.5
Median	50	**18.0**	**18.1**	**426**	**463**	**8.49**	**7.94**	**7.64**	**7.65**	**24.6**	**24.8**
	75	22.1	23.2	534	573	9.50	9.08	7.81	7.86	34.1	35.3
	95	24.7	24.9	775	849	10.5	10.5	8.18	8.15	79.0	56.4
	99	26.0	26.1	1031	985	11.3	10.9	8.47	8.37	131	82.2
	99.5	26.4	26.3	1086	1008	11.7	11.1	8.53	8.40	156	99.9
	99.9	26.9	26.6	1148	1046	12.0	11.3	8.61	8.44	315	184